ATTACHMENT VI
DESIGN REPORT

PRINCE EDWARD COUNTY SANITARY LANDFILL
PERMIT NO. 584

PRINCE EDWARD COUNTY, VIRGINIA

ORIGINAL : APRIL 2021
Resource International

MODIFIED : JANUARY 2023
LaBella Associates, D.P.C

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PRINCE EDWARD COUNTY SANITARY LANDFILL

DESIGN REPORT

APPENDICES

I. GENERAL

The Prince Edward County Sanitary Landfill is located approximately five miles west of the Town of Farmville, Virginia, off of State Route 648, approximately 1.5 miles south of U.S. Route 460. The site, and the surrounding area, is shown on the Overall Facility Map, Sheet 3 of the Part B Application Drawings. The Part A Permit application was approved by the Commonwealth of Virginia's Department of Environmental Quality (DEQ) Waste Division on September 14, 1992. The original Part B Application was approved in 1995 with Permit No. 584 being issued July 6, 1995.

This design report and the accompanying design plans were prepared by Resource International, Ltd. Resource International, Ltd. is a consulting engineering firm licensed to practice engineering in the State of Virginia. The owner of the site is Prince Edward County. The design plans have been prepared under contract to the County. The sources of solid waste are the waste collected in Prince Edward County, the Town of Farmville, and the nearby counties of Buckingham and Cumberland.

A total of six cells are proposed by this permit application, Cells A through F. The proposed phased development will allow for the continued operation of the landfill without disruption of disposal capacity. Cell construction will be phased so that each cell will be constructed before the current operating cell has reached its disposal capacity. After reaching capacity, portions of the landfill will be closed, as shown on Sheets 36 through 40 of the Part B Application Drawings.

Site life projections are generated by comparing the remaining capacity within a disposal cell, the daily waste tonnage received, and the compaction rate achieved by the facility operations. Projections may fluctuate over time based upon waste generation rates within the service area and variables such as new disposal options for private haulers.

The facility disposal cell specifications, approval dates and estimated site life are provided below:

Cell	Size (Ac)	Approved for Operation	Capacity (CY)	Site Life (YR)
A	4.6	2/17/97	233,910	5.4
B	3.1	5/22/97	281,871	5.4
C	3.35	12/17/04	311,710	5.7
D	3.52	5/6/09	277,074	5.1
E	3.46	3/8/17	331,787	5.1
F	3.44		369,602	5.7
Total	21.47		1,805,954	32.4

Phase I Closure was approved on 9-19-2007.

A. General Site Plans

The table of contents provided in Attachment III includes the list of permit drawings. Reduced Drawings are provided in Attachment III. Full Size Drawings have been attached separately.

B. General Facility Information

Project Title:

Prince Edward County Sanitary Landfill

Engineering Consultants:

Resource International, LTD
9560 Kings Charter Drive
Ashland VA, 23005
804-550-9200

Site Owner, Permittee, and Operator:

Owner/Permittee/Operator
Prince Edward County
County Administration Office
P.O. Box 382
Farmville, Virginia 23901

Permitted Acreage:

The current waste footprint of Permit # 584 is 21.47 acres.

Site Life and Capacity:

The current permitted airspace of Permit # 584 is approximately 1,805,954 cubic yards. The current estimated date of closure is 2030.

Site Monitoring Plan Sheet:

The Monitoring Plan (sheet 15) is located in Attachment III as part of the Design Drawings.

Municipalities, Industries and Collection and Transpiration Agencies served:

The Prince Edward County Sanitary Landfill will continue to serve residents of the County of Prince Edward, County of Buckingham, County of Cumberland, and commercial municipal solid waste haulers serving these areas.

Waste types and quantities to be processed

The Prince Edward County Sanitary Landfill shall not dispose of more than 300 tons of waste per day except under special conditions such as a natural disaster or severe storm damage that creates large quantities of waste and debris that must be handled expediently in an environmentally acceptable manner.

A permit amendment is required prior to exceeding 300 tons of waste per day.

The Prince Edward County Sanitary Landfill will accept:

a. Agricultural waste

b. Ashes and air pollution control residues that are not classified as hazardous waste. Incinerator and air pollution control residues should be incorporated into the working face and covered at such intervals as necessary to prevent them from becoming airborne.

c. Commercial waste

d. Compost

e. Construction waste

f. Debris

g. Demolition waste

h. Discarded material

i. Garbage

j. Household waste

k. Industrial waste meeting all criteria contained herein

l. Inert waste

m. Institutional waste except anatomical waste from health care facilities or infectious waste as specified in Waste Management Board's *Regulated Medical Waste Regulations*.

n. Municipal solid waste

o. Putrescible waste. Occasional animal carcasses may be disposed of within a sanitary landfill. Large number of animal carcasses shall be placed in a separate area within the disposal unit and provided with a cover of compacted soil or other suitable material.

p. Refuse

q. Residential waste

r. Rubbish

s. Scrap metal

t. Sludges. Water treatment plant sludges containing no free liquid and stabilized, digested or heat treated wastewater treatment plant sludges containing no free liquid may be placed on the working face along with municipal solid wastes and covered with soil or municipal solid wastes. The quantities accepted should be determined by operational conditions encountered at the working face. For existing faculties without an adequate leachate collection system, only a limited quantity of sludge may be accepted. A maximum ratio of one ton of sludge per five tons of solid waste per day will be considered. Generation of leachate will be a basis for restriction of sludge disposal at such existing facilities.

u. Trash

v. White goods

w. Non-regulated hazardous wastes by specific approval only

x. Coal Combustion By-Products / Fossil Fuel Combustion Products

y. Special wastes as approved by the Director

The landfill will not accept any hazardous waste (unacceptable waste) as defined by Virginia Hazardous Waste Management Regulations.

Part A approvals

The Part A Permit application was approved by the Virginia Department of Environmental Quality on September 14, 1992.

The DEQ placed the following conditions upon the approval of the Part A Permit Application for the site:

1. The disposal area shall consist only of the area identified as "Limits of Operation (38 acres)" on the Near Vicinity Map dated September, 1991.

   Cells A and B were constructed in accordance with the original Part B Application, and subsequent Permit No. 584. The proposed future cells C through F are located within the “Limits of Operation (38 Acres)” area defined in the Part A Application, Near Vicinity Map, September 1991. Further, the total disposal area of Cells A through F comprises only 21.90 acres.

2. Groundwater levels shall be collected from all wells onsite throughout the remainder of the permitting process.

   Groundwater levels have been collected as required.

C. Facility Design.

1. Floodplain.

No portion of the disposal facilities are contained within the 100-year floodplain.

2. Site Access.

The site will be accessed by an all-weather existing road from Virginia State Route 648. The access road is presently being used to service the disposal areas currently being operated. Access is limited by a gate, which is locked after hours, preventing access and illegal dumping. The locations of the gate, fencing, and access road are shown on Sheet 4 of the Part B Application Drawings. The traffic flow pattern for the site is such that all vehicles must pass a manned gate house and scale area. After being weighed, the traffic is then routed to the current operation area. The operating personnel and signage will direct traffic to the active disposal area via gravel access roads.

For drawings, profiles, and cross-sections of the proposed roads, refer to Sheets 24 through 26 of the Part B Application Drawings.

Hours of Operation

Access to the site by landfill customers will be limited to those hours when the scale attendant is present and on duty. The Prince Edward County Landfill will be operated (open for waste acceptance) during the following times:

Monday through Saturday	8:00 a.m. to 4:00 p.m. (0800 to 1600)
Sunday	CLOSED

The hours of operation will be posted at the landfill. Normally, the landfill will be closed on the following holidays:

New Year's Day	Labor Day
Thanksgiving	Christmas

The hours of operation occasionally may be revised to accommodate temporary increases to waste disposal rates such as may be needed to handle debris and wastes resulting from natural or man-made disasters, large construction / revitalization projects, or large sporting/social events.

Traffic Routing

The site will be accessed by asphalt paved road from Virginia State Route 648. Internal gravel-paved landfill access roads will be provided around the perimeter of the proposed cells. The site will be fenced with a locking gate across the access road that will prevent after-hours access and illegal dumping. After entering the site, the vehicles will proceed to the scale area. Here vehicles will be weighed and inspected. The vehicles will then proceed to the appropriate unloading area. Directions can be either verbal, by means of signs, or other appropriate method.

Vehicles traveling to the working face will drive down the access road to an internal road to the working face. These internal roads will be temporary and will be relocated as needed. Empty vehicles will exit the cell through internal roads to the perimeter road then exit the landfill via the paved entrance road.

The paved access road should eliminate mud from being tracked off-site. Every effort shall be made to keep access roads free of mud and dust.

In dry periods, water or other dust inhibiting agents will be applied to the roads to keep dust to a minimum. When needed, additional gravel or other appropriate road materials will be applied to keep roads passable under all conditions. All roads will be constructed with a cross slope to ensure drainage from the roadway surface.

All visitors will report to the scale attendant on duty, sign in, and park in the designated area indicated by the attendant. No unaccompanied visitors will be allowed on the site for any reason.

In the event of inclement weather conditions, landfill design considerations will permit the continued operation of the landfill. Daily cover material will be stockpiled adjacent to the working face for daily cover. The access roads will be kept passable at all times. In wet conditions additional road base will be available to stabilize soft spots in the landfill's internal roads. During cold weather, salt and/or sand shall be applied to icy spots on the access road to ensure good traction. During windy weather fences or additional cover material shall be used to control litter.

3. Shelter.

The scale house is provided with heat, lighting, and sanitary facilities. Telephone service is available at the scale house. All support facilities are enclosed to provide protection from the elements during periods of inclement weather. For locations of these facilities, refer to Sheet 4 of the Part B Application Drawings.

4. Aesthetics.

Natural screening for the site is provided by mature trees surrounding the site on all sides. An existing forested area will be reserved along the north and west property boundaries

Noise will be attenuated by the use of natural buffer zones wherever feasible and the use of mufflers on all equipment with an internal combustion engine. This will include equipment used during the construction of cells and daily operation of the landfill. At no time shall sound levels be greater than 80 dBA at the site boundary. In the event that residential development occurs in the near vicinity of the landfill, further noise attenuation steps will be considered.

No long-term use of the property other than open space or perhaps a natural area is currently contemplated although another use may ultimately be considered. If plans for long term use of the property change, the County will notify the DEQ and submit a permit application for the proposed long term use of the property.

5. Location of Cells.

The facility will comprise six disposal cells. The access roads will remain passable in all weather conditions. In no case shall waste be deposited on unlined areas.

For locations of the waste disposal cells, refer to the individual phase grading plans on Sheets 9 through 14 of the Part B Application Drawings.

6. Benchmarks.

A permanent construction base line and survey grid has been established for the site. Site benchmarks are provided for purposes of maintaining horizontal and vertical control for construction, operating and monitoring activities. The vertical control benchmarks have been changed to State Plan NAD83 from the vertical and horizontal datum used by Prince Edward County Sanitary Landfill. Benchmarks, horizontal control monuments, and the baseline are shown on Sheet 17, along with coordinates, elevations, and a description of the benchmark.

7. Borrow and Stockpile Areas.

Various types of materials needed for daily operations, construction, and closure of the landfill will be stockpiled as needed. Each stockpile will have all necessary erosion and sedimentation controls and will be temporarily seeded if left undisturbed for longer than 30 days.

Stockpile locations for individual phases are shown on the individual phase grading plans Sheets 10 through 14 of the Part B Application Drawings. Material quantities (excavation, road materials, etc.) are also shown on the individual phase grading plans which indicate required construction and operational materials for each phase. Appendix 2-H provides a calculation of the daily cover stockpile amount - 117 cy. This represents a minimum of three-day’s worth of daily cover material.

Stockpiles required during cell construction will be located as needed, at the discretion of the owner, the landfill contractor operator, and the construction contractor. Stockpiles will be provided with adequate erosion control, and will be temporarily seeded if they are to remain in place for more than 30 days.

D. Site Conditions.

Refer to the Facility Solid Waste Permit, Module I, Section F for a complete list of Site-Specific Conditions.

II. SITE DESIGN

A. Landfill Unit Design.

Regulatory Requirement

The proposed permit amendment complies with the design standard as outlined in 9 VAC 20-81-130.J.1.b. The geomembrane will be in direct and uniform contact with the GCL Liner.

1. Liner Foundation.

This section discussed various aspects of the liner foundation design. The liner foundation consists of native residual soils and compacted structural fill. The structural fill will be placed on top of the native soils, where necessary, to achieve the design Subgrade elevations for the liner.

Per DEQ Regulations, a separation distance between the seasonal water table and the liner system is not required. However, the proposed liner system design will maintain a minimum of three feet separation between the liner system and the water table.

The proposed subgrade elevation for Cell E and Cell F will be raised two feet to account for the replacement of the currently approved 24" of Clay Liner for the proposed Geosynthetic Clay Liner.

Reasoning and Logic

This design approach is consistent with the previously permitted and constructed landfill cells. It reduces excavation quantities and clay borrow acquisition.

2. Liner System.

The first layer of the liner system above the liner foundation proposed for Cells E and F will consist of a Geosynthetic Clay Liner (GCL). The GCL shall have a permeability of 1×10^{-9} cm/sec or less. The GCL shall conform to and be installed in accordance with the QA/QC Program and the Technical Specifications.

The previously constructed first layer for Cells A thru D consisted of two feet of soil having a hydraulic conductivity of 1×10^{-7} cm/sec. or less.

The second layer of the liner system directly above the GCL or Compacted Soil consists of a 60-mil textured high density polyethylene (HDPE) flexible membrane liner (FML). The FML shall conform to and be installed in accordance with the QA/QC Program and the Technical Specifications.

The Leachate Collection and Control System (LCS) will be constructed above the proposed Liner System to protect the liner system from exposure.

Reasoning and Logic

The proposed change from two feet of soil to a GCL is based on the approved alternative liner system in accordance with 9 VAC 20-81-130.J.

3. Leachate Collection and Control.

The purpose of the Leachate Collection System is to collect and remove the leachate from the system so that no more than 12-inches of head is on the liner, excluding the sump. Where the leachate collection system consists of geocomposite, the maximum head on the liner system will be limited to the thickness of the geocomposite.

a. LCS Description

The Landfill Cell Design consists of a Cushion Geotextile, an 18" Granular Drainage layer (permeability of 5.8×10^{-3} cm/sec. or greater), and a Filter Geotextile.

Installed with-in the Granular Drainage layer and on-top of the geocomposite drainage layer will be a network of collection pipes that will direct the leachate to a collection sump. The leachate will be pumped from the collection sump via a side slope riser and thru a force main to the Leachate Management Area. Leachate is then pumped and hauled to a Treatment Facility (POTW).

b. LCS Design

The Leachate Collection System is designed to direct all collected leachate to the low area of each cell. There is a minimum grade of 2.0% from all points on the FML to the leachate collector. The grading of the FML assures that leachate will drain to the Leachate Removal System. The LCS piping is installed at a minimum slope of 2% to the collection point or sump for the LCRS. For the location and details of the various LCS components, refer to the Part B Application Drawings.

Reasoning and Logic

The proposed Granular Drainage layer design is consistent with the current approved and constructed design at the site.

The proposed permit amendment will not make any changes to the approved leachate collection and control design.

4. Leachate Removal System.

The Leachate Removal System utilizes a Side Slope Riser System for removal of leachate from the sumps. The leachate pumps located with-in the side slope riser will convey the leachate to the leachate management area located on-site. For the location and details of the various LCS components, refer to the Part B Application Drawings.

Reasoning and Logic

The proposed leachate removal system is consistent with the current approved and constructed design at the site. This design has been used successfully at numerous landfills.

The proposed permit amendment will not make any changes to the approved leachate removal system.

5. Stability.

The stability of the liner system components is addressed in Appendix F.

Reasoning and Logic

The Friction Angle of 22° that was utilized in the Stability analysis and established for the HDPE Liner System will also be utilized for the Geosynthetic Clay Liner. This will make the currently approved stability analysis applicable to the proposed bottom liner system modifications.

6. Leachate Disposal.

The following Leachate Disposal Methods will be utilized:

Pump and Haul

As a supplement to the direct force main discharge, the facility will also implement a pump and haul process for the disposal of leachate.

Leachate Recirculation

Leachate recirculation can be recirculated into the waste mass of Cells A thru D. Recirculation will be accomplished in accordance with the current Permit. A Permit Amendment will be required prior to any leachate recirculation with-in the waste mass of Cell E or Cell F.

Reasoning and Logic

The above leachate disposal methods are those utilized by the site under the current permit. No changes to the leachate disposal method are being proposed by this permit amendment.

B. Leakage Monitoring System

No leakage monitoring system is proposed for this site.

C. Collection and Storage Units.

The leachate management area consists of the following components:

- Leachate is pumped from the collection sumps via a force main system to the leachate management area.
- The leachate management area consists of composite lined pond with a volume of 73,216 cubic feet. (547,693 gallons)

Reasoning and Logic

The above Collection and Storage Units are those utilized by the site under the current permit. No changes to the system are being proposed by this permit amendment.

D. Run-on Control System.

The landfill cells have been designed to prevent storm water run-on from adjacent areas. The Run-on Controls have been design based on a 24 hour – 25 year storm event. For the various control measures to be used, refer to the Part B Application Drawings. Detail calculations are included in Appendix D.

Reasoning and Logic

The Run-on controls systems proposed are consistent with good engineering practice and currently utilized on-site. No changes to the system are being proposed by this permit amendment.

E. Run-off Control System.

The landfill Run-Off Control system consists of Surface Water Diversion Berms, Slope drains, Culverts, and Basins. The Run-off Controls have been design based on a 24-hour – 25-year storm event. For the various control measures to be used, refer to the Part B Application Drawings. Detail calculations are included in Appendix D.

Reasoning and Logic

The Run-off controls systems proposed are consistent with good engineering practice and currently utilized on-site. No changes to the system are being proposed by this permit amendment.

III. DESIGN CALCULATIONS

A. Landfill Liner Foundation

Design Description

The liner foundation will consist of a combination of the excavated soil subgrade or compacted structural fill, and the underlying soils.

Subsurface Exploration Data

The engineering characteristics of the foundation materials were investigated by: 13 soil borings; nuclear logging using natural gamma radiation; laboratory testing of selected soil samples. The following is an excerpt from the Part A Application (September 1991) describing the general subsurface soil profile with depth:

• Surface Zone - This zone consists of completely weathered soil displaying well-developed pedological horizons (A and B horizons). This material has generally lost its visible remnant structure. This zone is not generally thicker than 5 to 10 feet.

• Intermediate Zone - Material in this zone has been weathered to a soil-like consistency. These soils usually retain some remnant structure of the parent rock, such as compositional banding, foliation, and jointing. Standard Penetration Test results are highly variable in this material, and can range up to 100 blows per foot.

• Partially Weathered Zone - This zone is transitional between the saprolite and the intact bedrock. Its characteristics range from soil-like to rock-like. Inward weathering from joints results in boulder-like masses, or in alternating soft and hard zones. Standard Penetration Test results are typically greater than 100 blows per foot. Auger borings typically reach refusal within this zone.

• Bedrock Zone - This zone begins where slightly weathered rock is encountered.

Location Relative to High Water Table

Fluctuations in the depth to ground water is discussed in detail in the Ground Water Monitoring Program. In general, the base grade of the landfill is approximately 2 to 3 feet above the seasonal high water table. In the event ground water is encountered during cell construction, in the form of slightly higher water table levels and/or spring breakouts, temporary construction dewatering and/or underdrains will be installed. The cross-sections shown on Sheets 18 through 20 of the Part B Application Drawings depict the relationship between the base grade and the high water table.

Laboratory Data

Laboratory data is described in detail in the Part A Application (September 1991), and in the geotechnical study performed for the original Part B Application.

Engineering Analysis

(1) Settlement Potential

Settlement was evaluated to assist in the facility design. Long-term loads imposed by the waste, leachate collection drainage layer, and capping system were considered. Loads imposed by the various layers of geomembrane, geotextile, and geonet were considered insignificant. Loads imposed by construction and operational equipment were considered transient, and insignificant compared to long-term loads. The settlement is estimated to be approximately 19.3 inches at the deepest portion of the landfill (see Appendix 2-A).

Immediate settlement will be that experienced during construction. Therefore, adjustments to grades and elevations will be performed prior to and during the placement of the liner system. Since the landfill is filled over the course of many years of operation, the difference between primary and secondary settlement should be imperceptible. Therefore, the estimated settlement of the liner foundation is considered to be total settlement. Differential settlement will be less than the total settlement. However, for liner strain considerations, the differential settlement was considered equal to the total settlement.

(2) Bearing Capacity and Stability

The bearing capacity of the liner foundation is estimated to be approximately 462.3 ksf. The landfill is anticipated to impose a load of approximately 7.38 ksf. Therefore, the bearing capacity of the liner foundation is adequate.

Various side slopes were analyzed for slope stability. Under static conditions the factor of safety was estimated to be 2.40. Under dynamic (seismic) conditions, the factor of safety was estimated to be 1.16. This considered a coefficient of lateral acceleration (Algermissen) of 0.21, and a soil amplification factor of 1.4.

(3) Bottom Heave or Blow-out

Since the liner is proposed to be located above the high water table, bottom heave or blowout is not a concern.

(4) Construction and Operational Loading

Onsite soils are anticipated to adequately support construction traffic. However, the surficial, silty, micaceous soils may be susceptible to damage if exposed to wet weather, and excessive construction traffic. This is consistent with the comments and recommendations provided in the geotechnical study performed for the original Part B Application (Appendix 2-L), and as well the observations during the construction of the existing Cells A and D.

a. Installation Procedures

In the case of areas requiring fill to achieve base grade, or areas requiring undercutting and backfilling at the base grade, structural fill shall be placed, compacted, and tested in specific lifts. Standard or typical earthwork compaction equipment shall be used. Technical Specification 2220 provides compaction criteria.

b. Liner Bedding

The liner system includes a cushion geotextile consisting of a minimum 10 oz/sy non-woven geotextile. This component was based specified based on consideration of the landfill loading, as well as the gradation of the open-graded stone proposed for use as the leachate drainage layer in Cells C through F. The cushion geotextile in this application guards against puncturing of the liner by the overlying stone material. Note that Cells A and B did not include a cushion geotextile because a sand material was used as the leachate drainage layer.

A minimum vertical distance between the wheels or tracks of construction equipment is necessary to guard against puncture of the liner. During construction, 48 inches of drainage material must be maintained between the liner and the tires of rubber-tired equipment. Low ground pressure track equipment must be used. Further, 18 inches of drainage material must be maintained between the liner and the tracks of such equipment.

c. Installation Inspections

The Technical Specifications (Part B Application Attachment VII) and the QA/QC Program (Part B Application Attachment VII) describe in detail the inspections, monitoring, sampling, and testing methods and frequencies to be followed during the preparation of the liner foundation. In general, excavation and structural filling (as needed) will be performed to the lines and grades required by the Drawings, Technical Specifications, and QA/QC Program. Structural fill, as previously described, will be placed, compacted, and tested in accordance with the Technical Specifications and QA/QC Program. After the base grade has been achieved, and before liner system construction, the base will be surveyed to confirm the grading meets the required tolerances. The actual base grade elevations are required to be within 0.1 feet of, but not higher than, the elevations as indicated on the Drawings.

B. Landfill Liner

The landfill liner design is that of the approved alternative landfill liner consisting of a Geosynthetic Clay Liner (GCL) and a flexible membrane liner.

The GCL material must have the following physical characteristics as required by the technical specifications

- A maximum permeability of 1×10^{-9} cm/sec
- A minimum shear strength of 22 degrees

The GCL material will be tested to ensure conformance with the project requirements as required by the technical specifications and quality assurance plan.

The flexible membrane liner must have the following physical characteristics as required by the technical specifications

- A 60 mil HDPE textured liner
- A minimum shear strength of 22 degrees

The flexible membrane liner will be tested to ensure conformance with the project requirements as required by the technical specifications and quality assurance plan.

Differential Settlement

Differential settlement is estimated to cause approximately 0.006 percent strain in the liner. Compared to the typical 12 percent strain at yield for HDPE liner, the factor of safety against the liner yielding in this situation is very high.

Anchor Trench Requirements

The anchor trench has been designed with a capacity of approximately 901.2 lb/ft (based on a unit one-foot width). The yield stress for 60-mil

HDPE geomembrane is 2100 psi, which equals 1512 lb/ft of width. The maximum side slope for the landfill is estimated to be approximately 95 feet. Analysis indicates that the liner is not in tension under its own weight, but is in tension under the stresses imposed by landfilling. The tension in the liner due to the stresses imposed by the waste filling is estimated to be approximately 384 lb/ft. Therefore, the following factors of safety (FS) are calculated:

- FS against the liner tension: 2.3 (the anchor trench will support the actual tension in the liner)

- FS against liner yield stress: 1.7 (the anchor trench will fail before the liner yields)

Both of these factors of safety are greater than 1.5, which is acceptable. The overall factor of safety against yield, based on the actual estimated stress in the liner, is 3.9. Design Report Appendix A contains detailed calculations.

<u>Integrity Under Mechanical Stresses</u>

Various construction vehicles were evaluated relative to the stress imposed on the liner system during construction. These vehicles were:

- Standard Dual Wheeled Dump Truck
- Cat 773 Off-Road Dump Truck
- D6H LGP Dozer (low ground pressure)

Based on the analysis, all rubber-tired vehicles must maintain at least 48 inches of material between the wheels and the liner during construction. For track equipment, 18 inches of material between the tracks and the liner must be maintained during construction. These material thicknesses allow the stresses imposed at the ground surface to be distributed with depth so that the resultant stresses acting directly on the liner are adequately controlled. During operation, the mechanical stresses of the equipment will be further diminished by the additional thickness of the waste layers.

Differential settlement of the subgrade, as described, is estimated to cause insignificant strain in the liner. Localized extreme settlement of the liner foundation was not considered since such an occurrence is not typical of the geologic area. Also, soft areas will be identified and repaired as needed during construction of the liner foundation.

See Design Report Appendix A for detailed calculations.

Slopes

The landfill cells have a proposed maximum grade of 4:1, which is typical for landfills. The stability of the liner system for these slopes was evaluated for full build-out conditions and operational conditions. The landfill liner system will be stable on the proposed grade of 4:1 based on the specified minimum interface friction requirements for the liner system components. Slope Stability calculations can be found in Design Report Appendix F.

Long Term Stresses

The long term stresses due to the placement of waste were considered in the design calculations. Specifically, the stability of the liner system under the full build-out loads were evaluated and interface friction requirements were developed for each interface in the liner and leachate collection system. Puncture protection of the geomembrane liner was evaluated and maximum particle size and placement requirements were developed for the layer below the geomembrane/GCL and the 18-inch gravel drainage layer above the geotextile cushion atop the geomembrane. Subgrade settlement was evaluated to insure that any settlement of the subgrade will not compromise the integrity of the liner system. Liner System Design calculations can be found in Design Report Appendix A.

Geomembrane Strength Requirements

The stability analyses of the liner system demonstrates that the geomembrane liner will be stable based on its frictional interaction with the materials above and below it. Therefore, the tensile strength of the geomembrane is not required for stability. The specified strength in the project specifications are based on current industry standards for the specified type of material (GRI specification GM-13).

C. Leachate Collection and Removal System

1. Leachate Flow.

The leachate flow was estimated by the use of the Hydrologic Evaluation of Landfill Performance (HELP) computer model.

Design Report Appendix B contains all HELP model results, and flow calculation summary tables. Refer to the Leachate Management Plan for additional information on leachate Flow Rates.

2. **Drainage Layer Design.**

The drainage layer has been designed and specified to be placed and constructed to: prevent failure of the liner system; filter and prevent migration of the fines to the drainage layer; limit the leachate head on the liner to less than 12 inches, except for sumps and/or manifolds.

Refer to the Leachate Management Plan for additional information on the Drainage Layer Design.

3. **Protection of Drainage Systems.**

The granular drainage layer will be protected by a Filter Fabric to prevent clogging.

Refer to the Leachate Management Plan for additional information on the Filter Fabric Design.

4. **Leachate Collection Pipe.**

The design of the leachate collection piping system considered the following design aspects:

- the peak flows as determined by the HELP modeling previously described
- the pipe spacing and slope
- the perforation sizing and spacing
- the structural stability of the pipe

Pipe diameters in Cells A and B are: 8 inches for the main header pipe; 6 inches for the lateral pipes. Cells C through F will have 6-inch diameter pipes for both headers and laterals.

Refer to the Leachate Management Plan for additional information on the Leachate Collection Pipe Design.

5. **Leachate Removal System.**

The main header pipe in Cell A penetrates the liner with a boot-style liner penetration. The main header in Cell B penetrates the liner with a slip-joint style of penetration. Both of these pipe drain by gravity to collection manhole just beyond the limits of each cell. From the collection manholes, the leachate flows by gravity to the leachate storage pond. The sump in Cell C, which serves Cells C through F, contains two, large diameter, slope riser pipes for the leachate to be removed by a pump and force main system. Only one slope riser will contain a pump. The second riser is reserved for emergency use as needed. From the sump in Cell C, leachate is directed by force main to the collection manhole at Cell A.

Leachate will be disposed of by either recirculation into the landfill, or pump and haul to a wastewater treatment plant, or combination of both. The Town of Farmville has agreed to accept leachate from the landfill (see Design Report Appendix L). Arrangements with other treatment works may be effected as needed.

Refer to the Leachate Management Plan for additional information on Leachate Removal System Design.

6. Run-on Control System.

Run-on flow will be prevented from entering the active portion of the landfill by diverting storm water run-off from upgradient and adjacent non-landfill areas around the landfill. Further, a system of surface diversion berms and down-slope channels (constructed with each phase of closure), and perimeter ditches direct storm water run-off from the landfill away from the active portion of the landfill to sediment basins.

7. Run-off Control System

Run-off will be controlled by the use of permanent perimeter ditches, stormwater berms, and down drains. During construction, run-off will be controlled by temporary diversion dikes and ditches. All proposed measures will be conveyed to a sediment basin.

Peak Flow and Design Volume

The permitted disposal area will be served by a series of surface berms, phasing berms, downslope channels, culverts, and perimeter ditches which will discharge to two stormwater sediment basins designed to satisfy the requirements of the Virginia Erosion and Sediment Control Handbook (VESCH). The peak flows for the channels and culverts were calculated using the Rational Method ($Q_{25} = CiA$). Sediment basins utilized the *Technical Release No. 55 - Urban Hydrology for Small Watersheds* (TR-55).

Design and Performance

The peak flows for the channels and culverts were calculated using the Rational Method ($Q_{25} = CiA$). This method was used because of the very low times of concentration calculated for the relatively small drainage areas on the landfill. These flow calculations were based on the peak 25-year, 24-hour intensity (i) values ranging from 3.83 to 8.10

inches per hour, depending on the time of concentration calculated (VDOT Plate 5-6 for Rational Method, City of Richmond). The drainage channels and culverts were designed using their respective worse case scenarios for run-off based on landfill cover, drainage area (***A***), time of concentration, and channel lining. The Manning=s ***n*** values used were 0.017 for block pavers, 0.025 for grass (includes EC-2 and EC-3), 0.038 for rip-rap, 0.013 for concrete pipe, and 0.012 for HDPE smooth wall pipe. Manning=s ***C*** values for the design were 0.30 for woodlands/fields and 0.60 for bare soil.

The peak flows for the hydraulic routing of the sediment basins were calculated using the SCS Curve Number Method (SCS Type II storm). This method was used because of the longer times of concentration possible for this calculation. The peak flow was based on the 25-year, 24-hour total rainfall of 6.0 inches. The peak flows for the 2-year, 24-hour (3.5 inches) and the 10-year, 24 hour (5.4 inches) total rainfall were also analyzed. As required by regulation, and thus shows to satisfy, the 2-year, 24-hour storm events have been detained to be less than or equal to the pre-development flows. All hydrology was computer generated using Watershed Modeling 7.0S by Eagle Point.

a. Sediment Basin 1

Pre-development analysis

- CN = 73
- Time of Concentration = 30 minutes
- Q_2 = 77.6 cfs
- Q_{25} = 214.5 cfs

Post-development analysis

- CN = 76
- Time of Concentration = 30 minutes
- Peak flow to Sediment Basin 1 during a Q_{25} storm was calculated by combining the actual Q_{25} storm and the Q_{25} routed storm from Sediment Basin 3
- Tailwater set at Elevation 390.75
- Assume worse case with initial water elevation at orifice invert
- Routed Q_2 = 19.1 cfs
- Routed Q_{25} = 217.6 cfs, Peak Elevation = 405.04

b. Sediment Basin 2

Pre-development analysis

- CN = 73
- Time of Concentration = 33 minutes
- Q_2 = 18.1 cfs

- Q_{25} = 49.9 cfs

Post-development analysis -CN = 88

- Time of Concentration = 36 minutes
- Peak flow to Sediment Basin 2 during a Q_{25} storm was calculated by the actual Q_{25} storm
- Tailwater set at Elevation 415.00
- Assume worse case with initial water elevation at orifice invert
- Routed Q_2 = 13.5 cfs
- Routed Q_{25} = 57.5 cfs, Peak Elevation = 428.54

Construction

The landfill top will be graded to a minimum slope of 5 percent and a maximum slope of 3:1 (33.33 percent). A series of surface diversion berms lined with permanent erosion control matting (VDOT EC-3) will intercept runoff every 20 vertical feet in elevation across the landfill. The diversion berms connect to down slope channels, lined with riprap, which direct the runoff flow to interior perimeter ditches, lined with either temporary or permanent erosion and sediment control matting (VDOT EC-2 or EC-3), or rip-rap. Runoff flow is directed in the perimeter ditches to culverts, RCP or HDPE, which convey it beneath the perimeter access road to exterior perimeter ditches. From that point, runoff flow is conveyed to one of the two sediment basins as indicated on the Drawings. The channels, culverts, and sediment basins will be constructed in accordance with the VESCH. Routine maintenance of the drainage structures will be required.

IV. CONSTRUCTION SPECIFICATIONS

The construction specifications sections for site construction are provided in Attachment VII in accordance with the regulations. The index sheet provided in Attachment VII includes the list of Technical Specifications.

V. QUALITY ASSURANCE AND QUALITY CONTROL.

A full time Quality Assurance/Quality Control (QA/QC) Program will be implemented during construction of the landfill to ensure that construction requirements are properly implemented and the design and performance standards of the landfill design are achieved. A copy of this QA/QC program is included as Attachment VII. As part of the QA/QC Program, documents including necessary photographs, will be maintained during construction to document compliance with the design plans and the specifications upon which the permit is based. The results of all tests performed to assure compliance with project plans and specifications (as described in the QA/QC program) will be compiled in a report prepared and sealed by an engineer licensed to practice in the State of Virginia. This report will contain the engineer's statement that the landfill was constructed in accordance with the plans and specifications.

If during the construction of the landfill, field conditions are encountered that are different than those anticipated in the Part A Permit Application, the QA/QC engineer shall be notified immediately and the conditions documented as they were encountered in the field. The certifying engineer may make minor changes to accommodate actual field conditions. If major changes are required, both the design engineer and the DEQ Waste Division shall be consulted prior to constructing revised designs.

A copy of the QA/QC Plan is provided in Attachment VII.

VI. GAS MANAGEMENT PLAN

The Landfill Gas Management Plan is located in Attachment IX.

VII. GROUND WATER MONITORING PLAN

The Landfill Ground Water Monitoring Plan is located in Attachment X.

VII. CLOSURE AND POST-CLOSURE CARE PLAN

The Landfill Closure and Post-Closure Care Plan is located in Attachment IV.

ATTACHMENT VI

APPENDIX F
Slope Stability

PRINCE EDWARD COUNTY SANITARY LANDFILL
PRINCE EDWARD COUNTY, VIRGINIA

P.N. 90094.18

November 2013

ATTACHMENT VI
APPENDIX F
SLOPE STABILITY DESIGN CALCULATIONS

Appendix F-1 contains the Slope Stability Analyses conducted for the Major Permit Amendment in support of using the Pre-approved Alternative Bottom Liner System (9 VAC 20-81-130.J.1.b). The purpose of these Analyses is to demonstrate that the inclusion of a Geosynthetic Clay Liner is stable.

Appendix F-2 contains the Slope Stability Analyses conducted for Permit Amendment No. 4. The purpose of this analysis was to demonstrate that the proposed change in the Interface Friction Angle was stable.

Appendix F-3 contains the Slope Stability Analyses conducted for Permit Amendment No. 3. These analyses demonstrated that the Liner System and Closure Cap were stable.

ATTACHMENT VI
APPENDIX F-1

SLOPE STABILITY ANALYSES

Bottom Liner System Stability
Prince Edward Landfill, Cell E-F
Prince Edward County, Virginia

REPORT

PROJECT

Slope Stability Analyses
Bottom Liner System Stability
Prince Edward Landfill, Cell E-F
Prince Edward County, Virginia

CLIENT

Resource International, Ltd.
9560 Kings Charter Drive
Ashland, Virginia 23005

SUBMITTED BY

Atlantic Geotechnical Services, Inc
10971 Richardson Road
Ashland, Virginia 23005

DATE

November 8, 2013

SLOPE STABILITY ANALYSES

Bottom Liner System Stability
Prince Edward Landfill, Cell E-F
Prince Edward County, Virginia

TABLE OF CONTENTS

APPENDIX

ATLANTIC GEOTECHNICAL SERVICES, INC.
Geotechnical + Materials Testing + Environmental

November 8, 2013
AGS Report No. RG13-557

Mr. Charles Wilson, P.E.
Resource International, Ltd.
9560 Kings Charter Drive
Ashland, Virginia 23005

Reference: Slope Stability Analyses
Bottom Liner System Stability
Prince Edward Landfill, Cell E-F
Prince Edward County, Virginia

Dear Mr. Wilson:

Presented herein are the results of Atlantic Geotechnical Services, Inc. (AGS) slope stability analyses to evaluate the stability of the alternate bottom liner system at this site for Cells E-F.

Purposes and Scope of Work

The purpose of our analyses was to assess stability of the proposed bottom liner system for Cells E-F. The results of our analyses are included in subsequent sections of this report.

Limitations

The analyses performed for this report were based solely on the data provided by others.

10971 Richardson Road, Ashland, Virginia 23005 • 804-550-2203 • FAX 804-550-2204

Purpose

The purpose of this study is to provide slope stability calculations demonstrating the stability of the alternative bottom liner system for Cells E and F. The adjacent Cell D of this landfill has been constructed and partially filled. Cell E which is contiguous and to the East of Cell F is to be filled next. Concern has been expressed by DEQ about the stability of the bottom liner system upon placement of waste on the site.

Design Parameters

Plans currently call for the bottom to be cut and filled with structural fill and a liner up to El 269. Next, waste will be placed in the landfill with a maximum side slope of 3-horzontal to 1-vertical. This waste will be carried across the bottom of the landfill in horizontal layers over to the constructed embankment.

AGS has been provided the results of adhesive tests between a 60 mil textured HDPE and; 1) a compacted clay liner; 2) a Geo-synthetic Clay Liner; and 3) a non-woven Geotextile (see Cumberland Geotechnical Consultants, Inc. report dated December 21, 2004; RE: Slope Stability Review, Cell C, Prince Edward County Landfill).

The waste, soil and liner strengths we used are the same used in the Cumberland Geotechnical Consultants, Inc. report and analyses and are as follows:

Material	Strength		Unit Weight, pcf
	Cohesion, pcf	Ø	
Waste	0	33°	75
Bottom Liner System	0	22°	90
Gravel/Drainage	0	38°	90
Clay	100	25°	90

The waste was taken to extend to its full height (EL 270 to 470) and at a 3-horizontal to 1-vertical slope (even through the height of the waste will be much less as it is to be placed in horizontal layers). The thickness of the drainage layer (open graded stone) was modeled to be a consistent 1.5-ft thick. Even though the interfaces between the soil and the liner material (CL over 60mil HDPE over cushion geotextile) is technically a very thin layer. We modeled it as being 0.5-ft thick which will provide a more conservative factor of safety.

Analyses

The critical stability configuration was taken when the toe of the waste is bearing on the bottom of the liner.

Calculations

The slope stability analyses were performed using an in-house computer aided software developed by others (GSTABL7 w/Stedwin). The previously described slope configurations and soil parameters were used in our analyses. Slope stability is evaluated by calculating the factor of safety against failure for various slopes. A factor of safety less than 1.0 indicates the slope will fail or has failed. The desirable factor of safety against slope failure is generally related to the consequences (economics, loss of life, etc.) of a failure occurring. Where possible loss of life (and/or very high economic loss) is involved, the factor of safety is higher. Where possible loss of life is not involved and the economic loss is relatively low, then a lower factor of safety is acceptable. The other factor involved in selecting an acceptable factor of safety is the accuracy of the parameter themselves; i.e., the more accurately known the soil parameters are and the more conservative the soil parameters, the lower the acceptable factor of safety.

Bottom Liner System Stability Results

The first slope stability analysis was for static loading only using the above referenced parameters. Since the GCL/Liner interface zone is the recognized, weaker layer in the system, we looked at both circular and non-circular methods of analyses. The lowest calculated factor of safety for this condition was 2.5 (Figure 1).

The second slope stability analysis was for seismic loading using a peak acceleration of 0.22g and the above referenced parameters. Again, we looked at both circular and non-circular failure methods of analyses due to the thin, weaker zone. The lowest calculated factor of safely for this loading was 1.1 (Figure 2). Graphs showing both results are included in the Appendix to this report.

Based on the above, this bottom liner system is considered to be stable.

* * *

We hope this helps provide some of the information needed for your decision process on this issue. Please call if you have any questions.

Sincerely,

ATLANTIC GEOTECHNICAL
SERVICES, INC.

Michael O. Noggle, P.E.
Principal Engineer

COMMONWEALTH OF VIRGINIA
MICHAEL O. NOGGLE
Lic. No. 019495
PROFESSIONAL ENGINEER

MON/ep
Enclosures

Copies Submitted: Above (4 bound, 1 unbound)

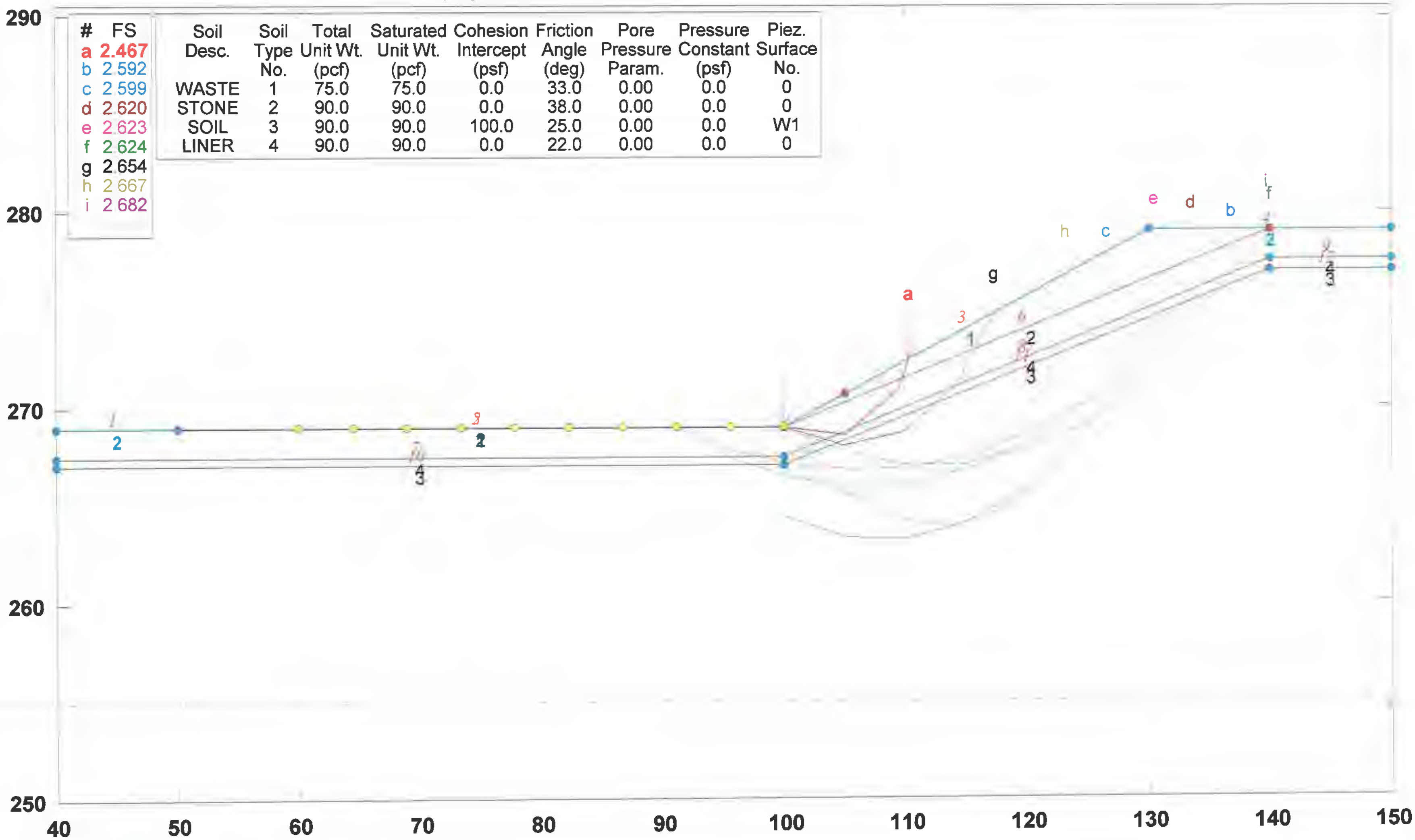
APPENDIX

Figures 1 & 2: Slope Stability Analyses Results

Figure 1 Graph
Static - Stability

PRINCE EDWARDLANDFILL ALTERNATE BOTTOM LINER SYSTEM STABILITY

c:\program files\g72sw\-newfile.pl2 Run By: noggle 11/13/2013 08:16AM



#	FS
a	2.467
b	2.592
c	2.599
d	2.620
e	2.623
f	2.624
g	2.654
h	2.667
i	2.682

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
WASTE	1	75.0	75.0	0.0	33.0	0.00	0.0	0
STONE	2	90.0	90.0	0.0	38.0	0.00	0.0	0
SOIL	3	90.0	90.0	100.0	25.0	0.00	0.0	W1
LINER	4	90.0	90.0	0.0	22.0	0.00	0.0	0

GSTABL7 v.2 FSmin=2.467

Safety Factors Are Calculated By The Simplified Janbu Method

GSTABL7

Figure 2 Graph
Seismic - Stability

PRINCE EDWARDLANDFILL ALTERNATE BOTTOM LINER SYSTEM STABILITY

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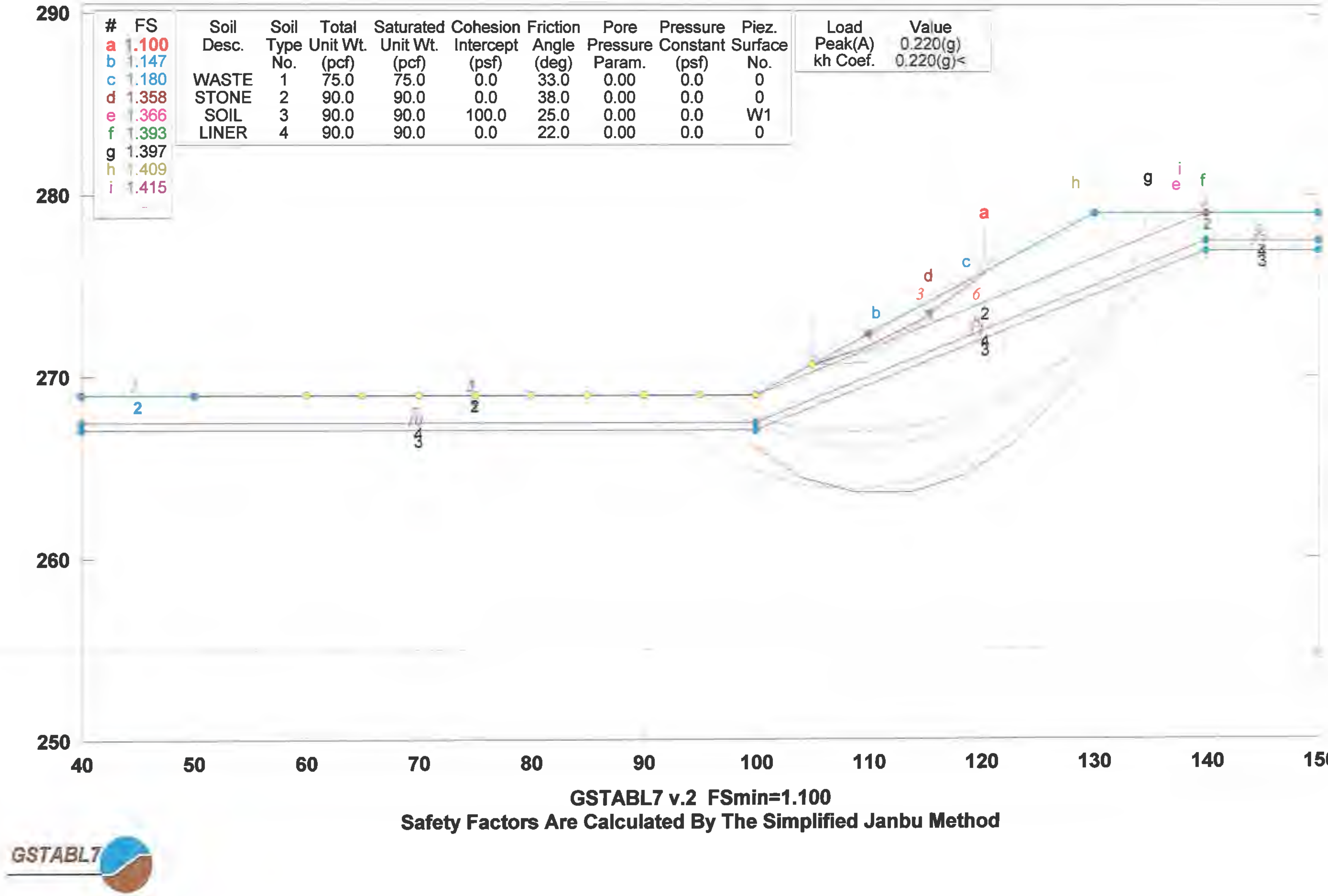


#	FS
a	1.100
b	1.147
c	1.180
d	1.358
e	1.366
f	1.393
g	1.397
h	1.409
i	1.415

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
WASTE	1	75.0	75.0	0.0	33.0	0.00	0.0	0
STONE	2	90.0	90.0	0.0	38.0	0.00	0.0	0
SOIL	3	90.0	90.0	100.0	25.0	0.00	0.0	W1
LINER	4	90.0	90.0	0.0	22.0	0.00	0.0	0

Load	Value
Peak(A)	0.220(g)
kh Coef.	0.220(g)<

GSTABL7 v.2 FSmin=1.100

Safety Factors Are Calculated By The Simplified Janbu Method

ATTACHMENT VI
APPENDIX F-2

90094.18

CUMBERLAND
GEOTECHNICAL
CONSULTANTS, INC.

ORIGINAL ______
COPY Ed Hollos

RECEIVED
JAN - 7 2005
RESOURCE INTERNATIONAL

December 21, 2004

Mr. Ed Hollos
Resource International, ~~Ltd.~~
P.O. Box 6160
Ashland, Virginia 23005

RE: Slope Stability Review
Cell C
Prince Edward County Landfill
Prince Edward County, Virginia

Dear Mr. Hollos:

In accordance with your request and at the request of the Virginia DEQ, we have completed a brief static slope stability analysis for the referenced project.

This report presents the methods and assumptions utilized in our engineering analyses along with supporting documentation, a summary of results and our conclusions regarding long term slope stability with the existing geosynthetic materials utilized during construction of Cell C at the Prince Edward County landfill in Prince Edward County, Virginia.

The stability analyses documented by this report predict long term slope stability of a two-part failure surface that combines the planar base liner section surface and an irregular surface within the landfill mass to produce a sliding block failure mode.

Please note that this stability analysis examines only Cell C at the above referenced facility and does not intend to analyze any other areas, cross-sections or capping components of the project site.

The sliding block surface analyses presented herein use the computer program GEOSLOPE, Version 5.50. This program was written by the Geocomp Corporation of Acton, Massachusetts and is based upon the widely recognized program STABL4M developed at Purdue University under the sponsorship of the Federal Highway Administration. It was supplied under exclusive license to Cumberland Geotechnical Consultants, Inc. The sliding block analyses use the Simplified Janbu Method of Slices for Irregular Surfaces to compute factors of safety. Computer input data and output results are attached.

Our review of the Cell C excavation and final contour drawings provided by Resource International, Ltd. resulted in the selection of one (1) representative and potentially critical landfill cross section for further evaluation. The primary criteria controlling the selection of this critical section was the steepest excavation slopes in conjunction with representative refuse heights and excavation geometry. A location plan and cross section of the representative and potentially critical section are attached.

Our laboratory tests of the geosynthetic landfill liner materials utilized for the construction of Cell C have provided the following results:

INTERFACE	FRICTION ANGLE	ADHESION
60 mil Textured HDPE / Compacted Clay Liner	22.6°	0 psf
60 mil Textured HDPE / Geosynthetic Clay Liner	25.3°	14 psf
60 mil Textured HDPE / Nonwoven Geotextile	23.3°	0 psf

The values listed above are based upon actual tests from actual materials utilized during construction as requested by Resource International, Ltd. and performed by Cumberland Geotechnical Consultants, Inc. in October 2004. Laboratory test results are attached.

The sliding block analyses compute stability for a two-part failure surface that combines the planar sliding surface along the base liner system with an irregular surface through the landfill mass. The GEOSLOPE program selects an irregular surface by iteration to assess the worst case within a given boundary and then evaluates it via the Simplified Janbu Method of Slices. The minimum interface shear strength used for this analysis was created by the interface of the compacted clay liner against the 60 mil textured HDPE primary liner. The following analysis incorporates a conservatively reduced test result of a friction angle of 20 degrees with zero adhesion.

The following stability analysis also requires evaluating the engineering properties of municipal solid waste. One of the most important properties to the stability analysis, and probably the most difficult to evaluate is the shear strength of refuse. Recent work on this subject was completed in 1998 by Dr. Timothy Stark at the University of Illinois. Dr. Stark's paper entitled "Municipal Solid Waste Slope Failure II: Waste and Foundation Soil Properties" (Journal of Geotechnical and Geoenvironmental Engineering, May 2000, Volume 126, Number 5, pp. 397-407) updates the available laboratory and field data on the shear strength of municipal solid waste. This work by Stark et al results in an average strength envelope of 35 degrees with 522 pounds per square foot cohesion. In fact, Stark states, "Based on the literature study and back-calculation of field case histories, an average c' and ø' of 25 kPa (522 psf) and 35 degrees, respectively, may be appropriate for the design of municipal solid waste containment facilities." Due to the unknown waste stream at the Prince Edward County Landfill and the lack of historical unit weight data for placed waste at this project site, the following analysis conservatively utilized a friction angle of 33 degrees with a cohesion intercept of 0 pounds per square foot. A composite unit weight of compacted refuse and daily/intermediate cover soil of 75 pounds per cubic foot has likewise been utilized in the analysis.

An analysis was also performed using more typical waste properties with a friction angle of 35 degrees with a cohesion intercept of 500 pounds per square foot.

A conservatively assumed unit weight of 90 pounds per cubic foot with an internal friction angle of 25 degrees and 100 pounds per square foot cohesion was utilized for the subgrade soils in both analyses.

The following factors of safety were generated for the representative and critical cross section profile using a sliding block analysis and the Simplified Janbu Method of Slices:

Waste Properties	Static Factor of Safety
33° with 0 psf cohesion	1.97
35° with 500 psf cohesion	2.33

Based upon the available data gathered as part of this study, a brief slope stability analysis has been conducted on various components of the recently-constructed Cell C at the existing Prince Edward County Landfill in Prince Edward County, Virginia with the assumptions as noted above. The analysis produces a minimum static factor of safety against any potential mass slope failure of the Cell C permanent landfill slopes of 1.97 based upon the excavation and final contour grades presented to this office. This minimum static factor of safety is judged to be acceptable.

If you should have any questions concerning our analyses, comments and conclusions please do not hesitate to contact us.

Very truly yours,

CUMBERLAND GEOTECHNICAL CONSULTANTS, INC.

Blanda E. Nace, E.I.T.

COMMONWEALTH OF VIRGINIA
S. JEFFREY BARNES
No. 024698
PROFESSIONAL ENGINEER

S. Jeffrey Barnes, P.E.

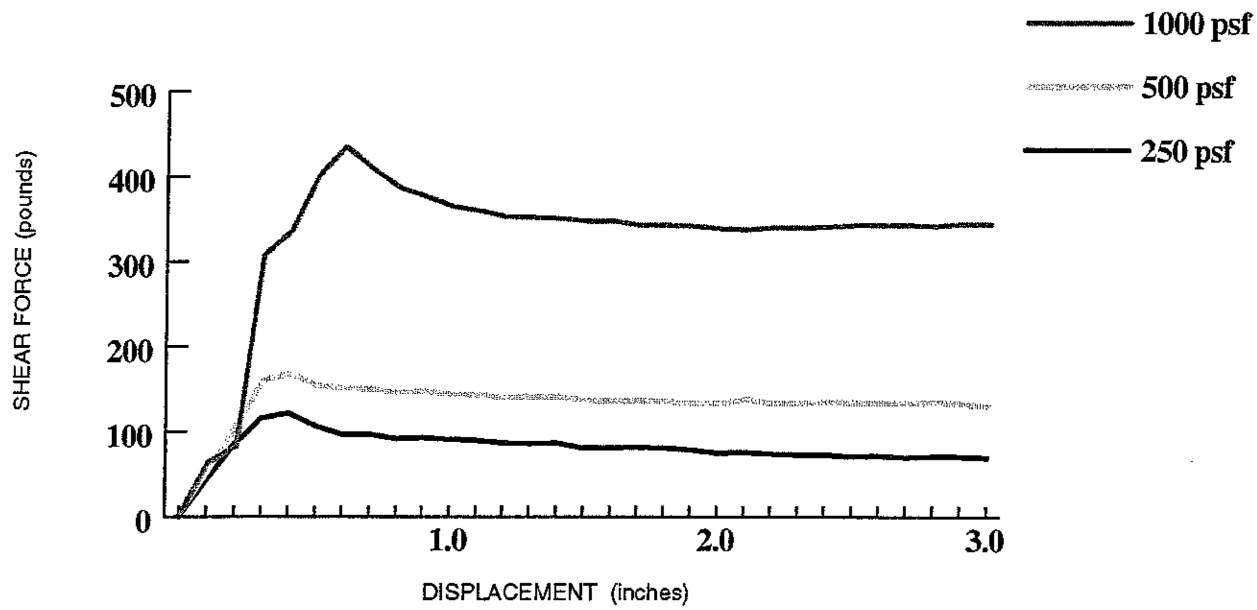
BEN/SJB/b
Attachments

CGC CUMBERLAND GEOTECHNICAL CONSULTANTS, INC.

801 Belvedere Street
Carlisle, PA 17013-4002
(717) 245-9100
Fax (717) 245-9656
www.cumberlandgeo.com

Standard Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction By the Direct Shear Method
ASTM Test Method D5321

Test No. 1
Interface: 60 mil Textured HDPE / Compacted Clay Liner



Geosynthetic/Soil Components in Shear Box	
Material	**Material Description**
Geotextile	SKAPS GT 116, 16 oz/yd²
Geomembrane	Agru America 60 mil textured HDPE
Interface	
Compacted Clay Liner	Well compacted on-site soil

Traveling Box (12" x 12")
Stationary Box (18" x 18")

Speed of Displacement = 0.04 inch/minute

Project No. 04-1647
Cell C
Prince Edward County Landfill
Prince Edward County, Virginia
October, 2004

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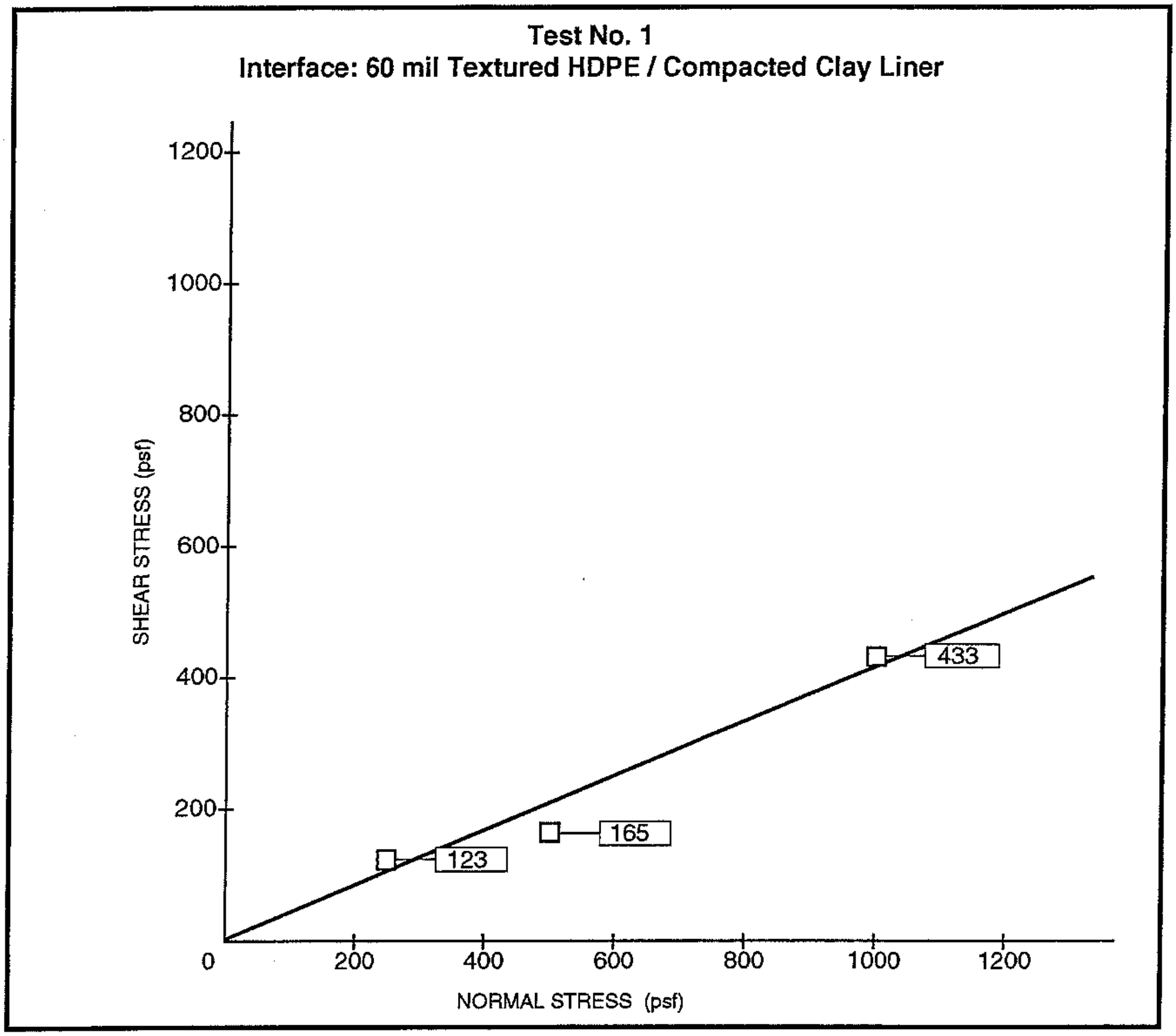

TEST RESULTS

Shear Strength at Peak	
Adhesion:	0 psf
Friction Angle:	22.6°

Project No. 04-1647
Cell C
Prince Edward County Landfill
Prince Edward County, Virginia
October, 2004

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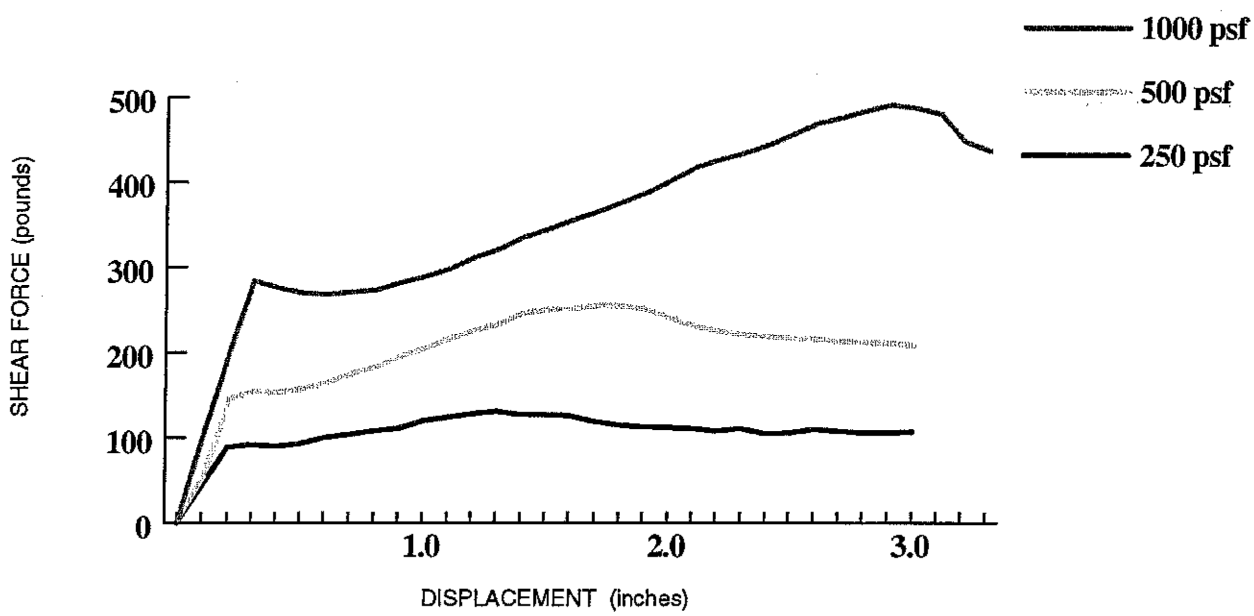
Standard Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction By the Direct Shear Method
ASTM Test Method D5321

Test No. 2
Interface: 60 mil Textured HDPE / Geosynthetic Clay Liner



	Geosynthetic/Soil Components in Shear Box	
	Material	**Material Description**
Traveling Box (12" x 12")	Geosynthetic Clay Liner	Bentomat ST (white side up)
	Interface	
Stationary Box (18" x 18")	Geomembrane	Agru America 60 mil textured HDPE
	Compacted Clay Liner	Well compacted on-site soil

Speed of Displacement = 0.20 inch/minute

Project No. 04-1647
Cell C
Prince Edward County Landfill
Prince Edward County, Virginia
October, 2004

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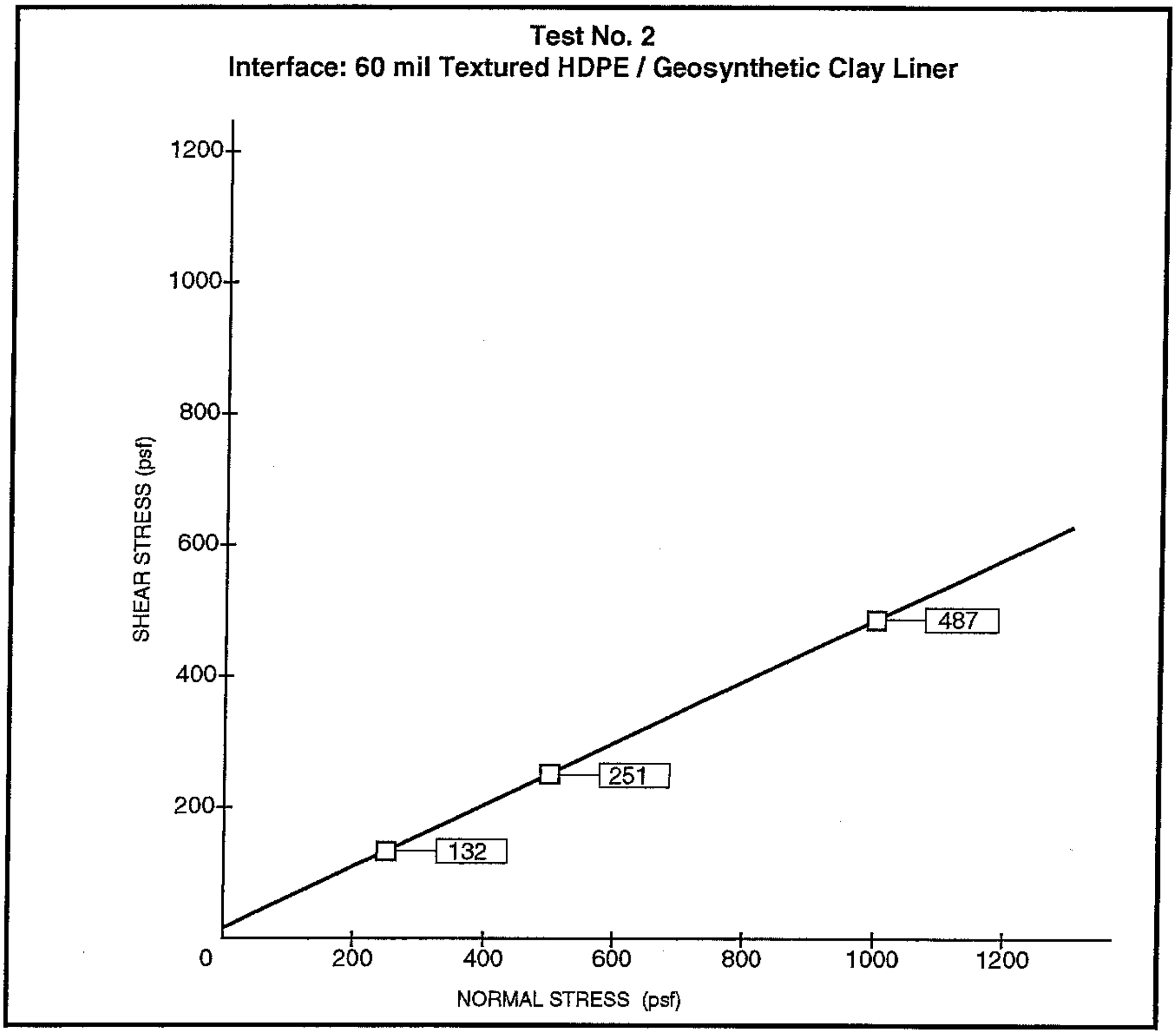
ASTM Test Method D5321



TEST RESULTS

Shear Strength at Peak	
Adhesion:	14 psf
Friction Angle:	25.3°

Project No. 04-1647
Cell C
Prince Edward County Landfill
Prince Edward County, Virginia
October, 2004

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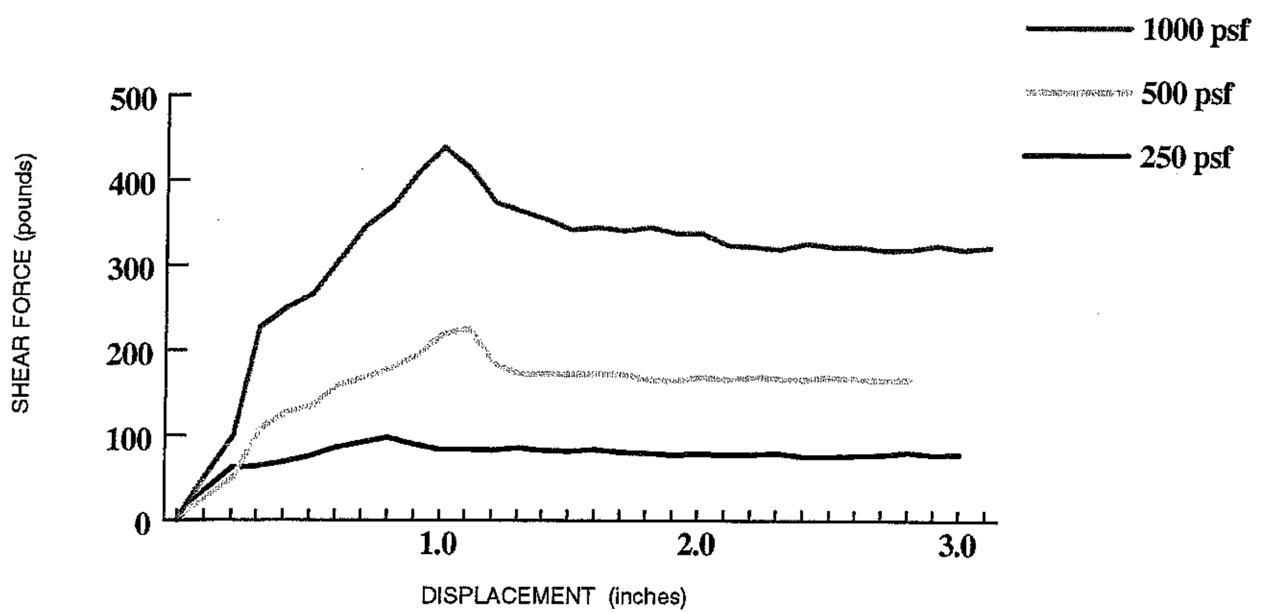
Standard Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction By the Direct Shear Method
ASTM Test Method D5321

Test No. 3
Interface: 60 mil Textured HDPE / Nonwoven Geotextile



Geosynthetic/Soil Components in Shear Box

	Material	Material Description
Traveling Box (12" x 12")	Nonwoven Geotextile	Skaps Industries 8 oz/sy geotextile
	Interface	
Stationary Box (18" x 18")	Geomembrane	Agru America 60 mil textured HDPE
	Compacted Clay Liner	Well compacted on-site soil

Speed of Displacement = 0.20 inch/minute

Project No. 04-1647
Cell C
Prince Edward County Landfill
Prince Edward County, Virginia
October, 2004

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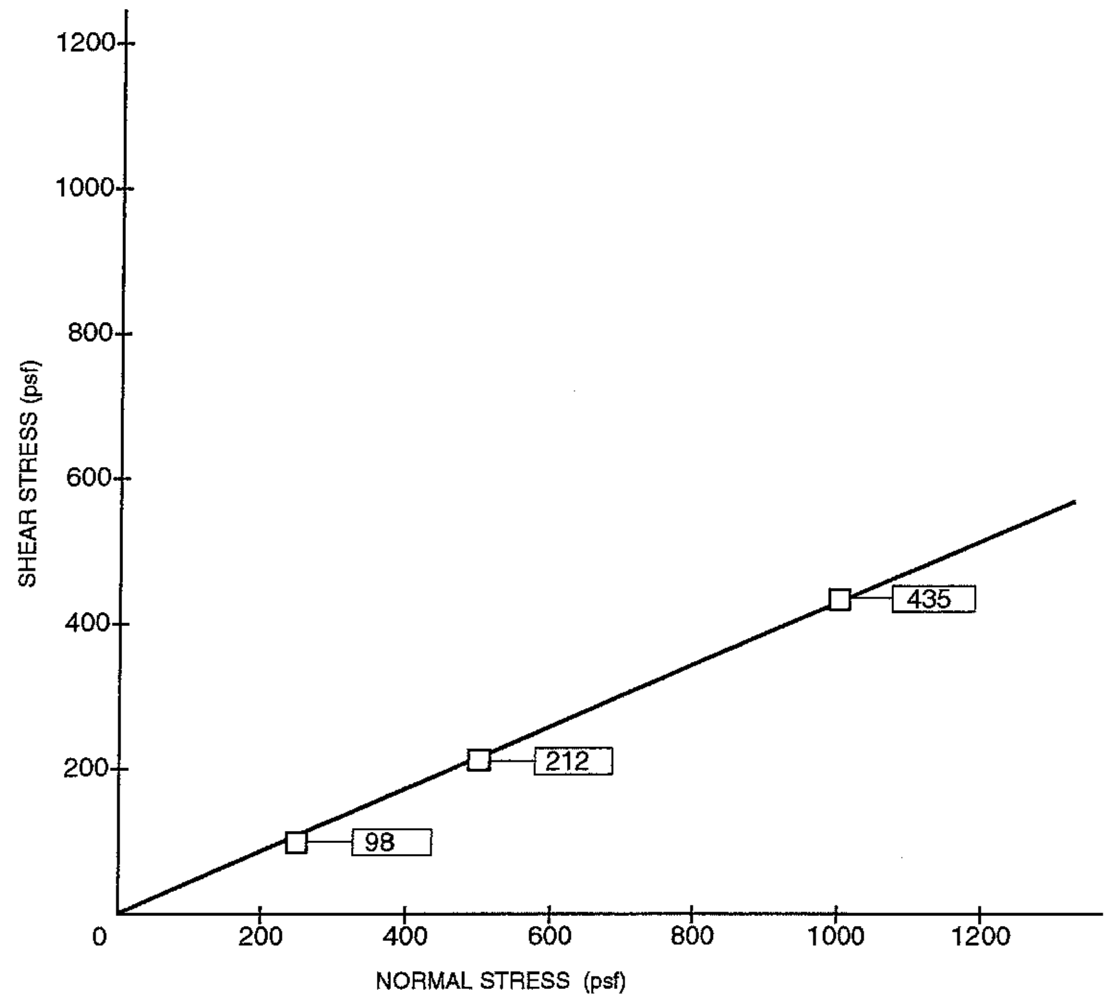
Standard Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction By the Direct Shear Method
ASTM Test Method D5321

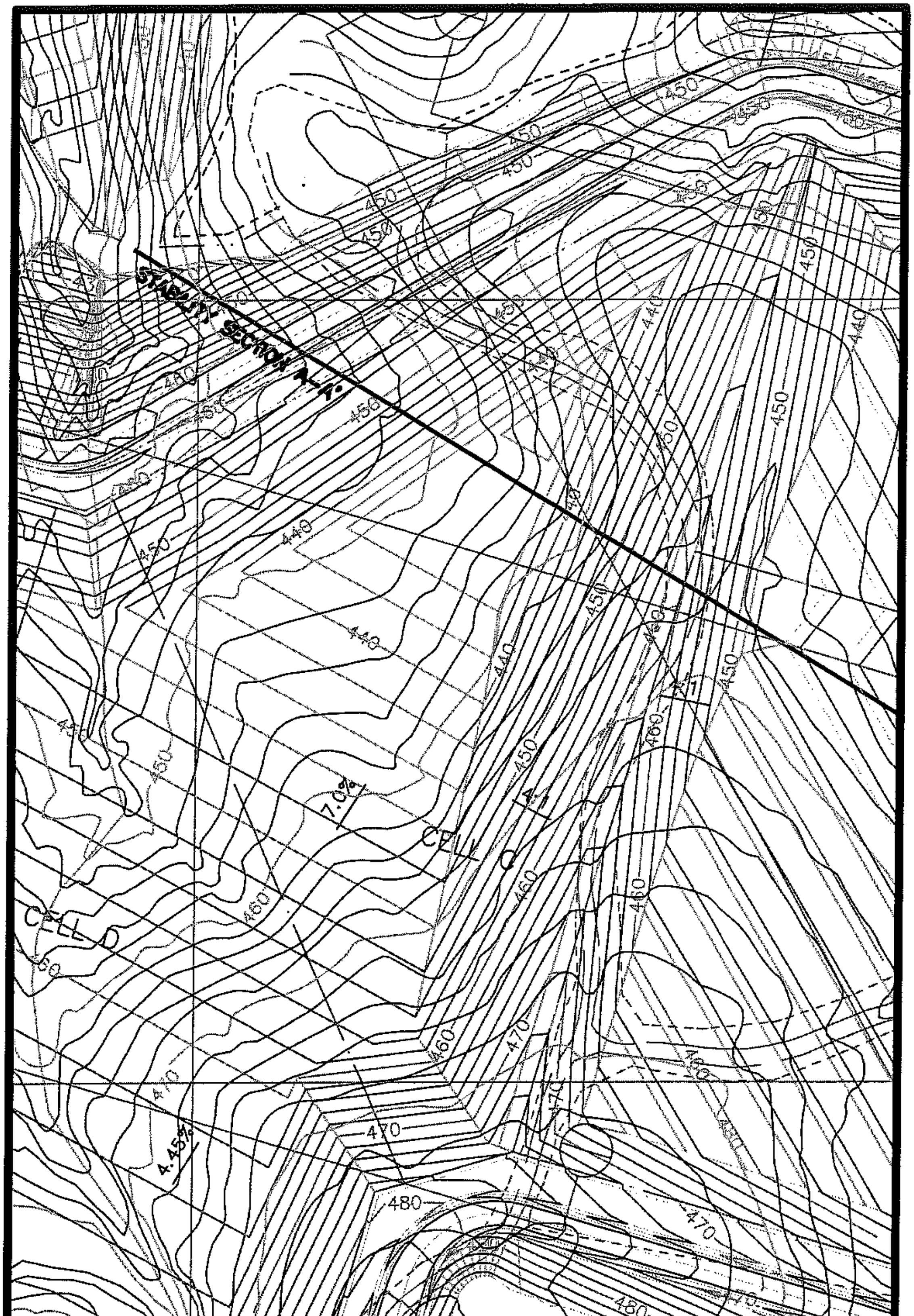
Test No. 3
Interface: 60 mil Textured HDPE / Nonwoven Geotextile



TEST RESULTS

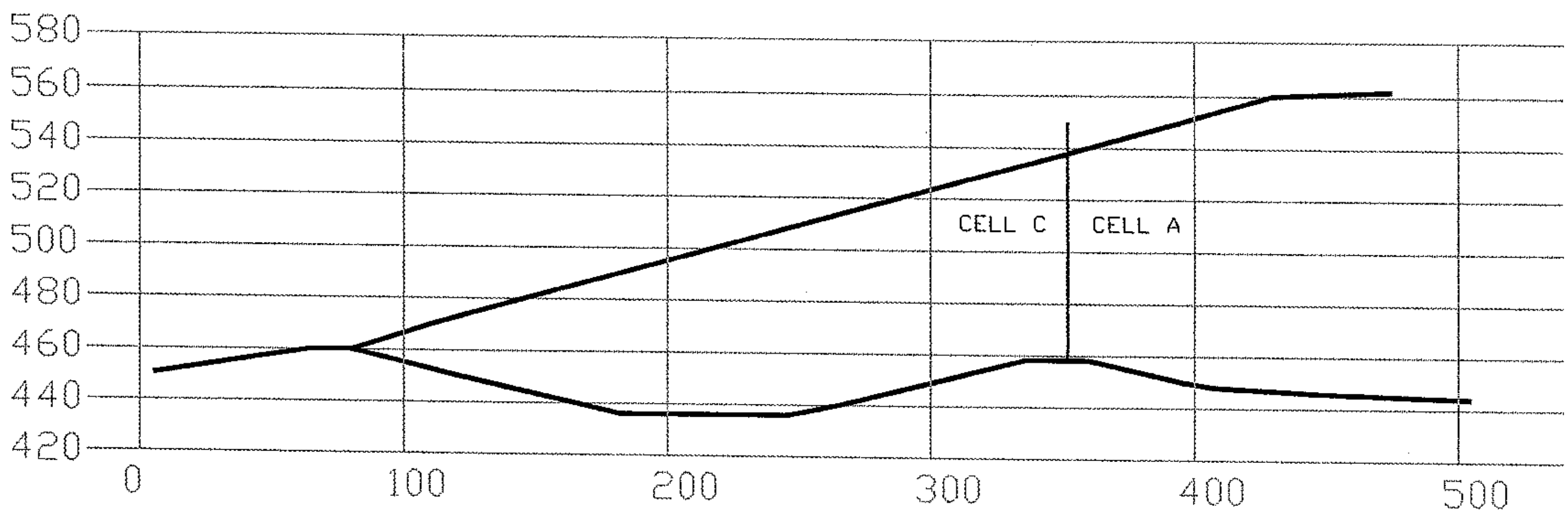
Shear Strength at Peak	
Adhesion:	0 psf
Friction Angle:	23.3°

Project No. 04-1647
Cell C
Prince Edward County Landfill
Prince Edward County, Virginia
October, 2004



PRINCE EDWARD COUNTY LANDFILL - CELL C
STABILITY CROSS SECTION A-A'

CUMBERLAND GEOTECHNICAL CONSULTANTS, INC
601 BELVEDERE STREET CARLISLE, PENNSYLVANIA 17013
www.cumberlandgcon.com



CROSS SECTION A-A'
PRINCE EDWARD COUNTY LANDFILL CELL C
RESOURCE INTERNATIONAL, LTD.
DECEMBER 2004

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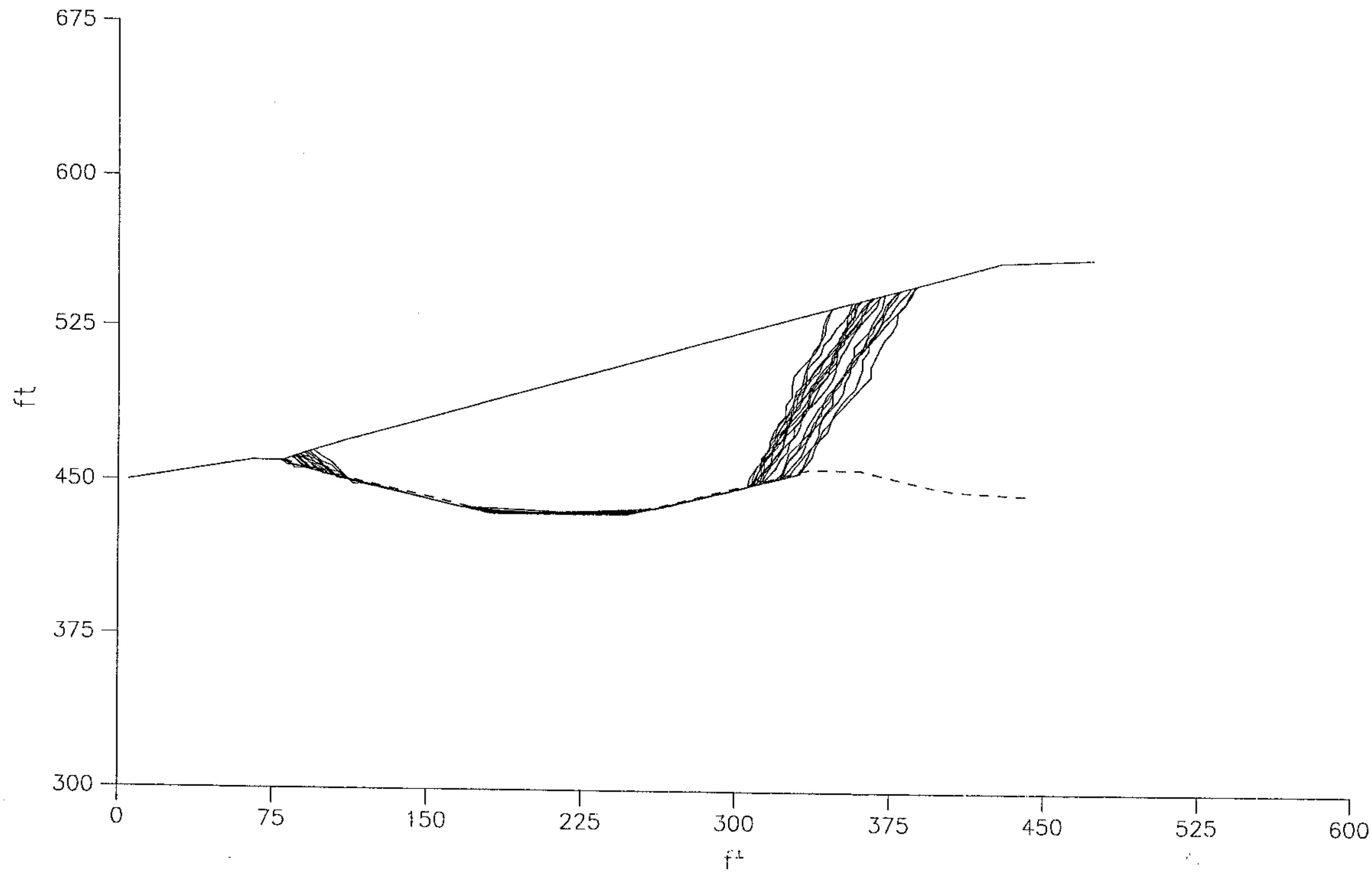
TITLE
Prine Edward County Landfill - Cell C
Section A-A'
Block Analysis

UNITS
1 1 1 1
OPTIONS
3 4 3 1 1 1
1 1 0
PROFIL
17 6
5 450 65 460 3
65 460 80 460 3
80 460 110 470 2
110 470 395 550 2
395 550 430 560 2
430 560 475 562 2
80 460 120 450 1
120 450 165 440 1
165 440 182 436 1
182 436 246 436 1
246 436 265 440 1
265 440 305 450 1
305 450 336 458 1
336 458 360 458 1
360 458 395 450 1
395 450 407 448 1
407 448 445 446 1
SOIL
3
75 75 0 20 0 0 0
75 75 500 35 0 0 0
90 90 100 25 0 0 0
BLOCK
20 7 5
80 459 119 449 0
120 449 164 439 0
165 439 181 435 0
182 435 245 435 0
246 435 264 439 0
265 439 304 449 0
305 449 335 457 0
END
```

Cumberland Geotechnical Consultants, Inc. Carlisle, PA 17013

Title: Section A-A'
Description: Block Analysis

Block Surfaces - Search for Critical Surfaces

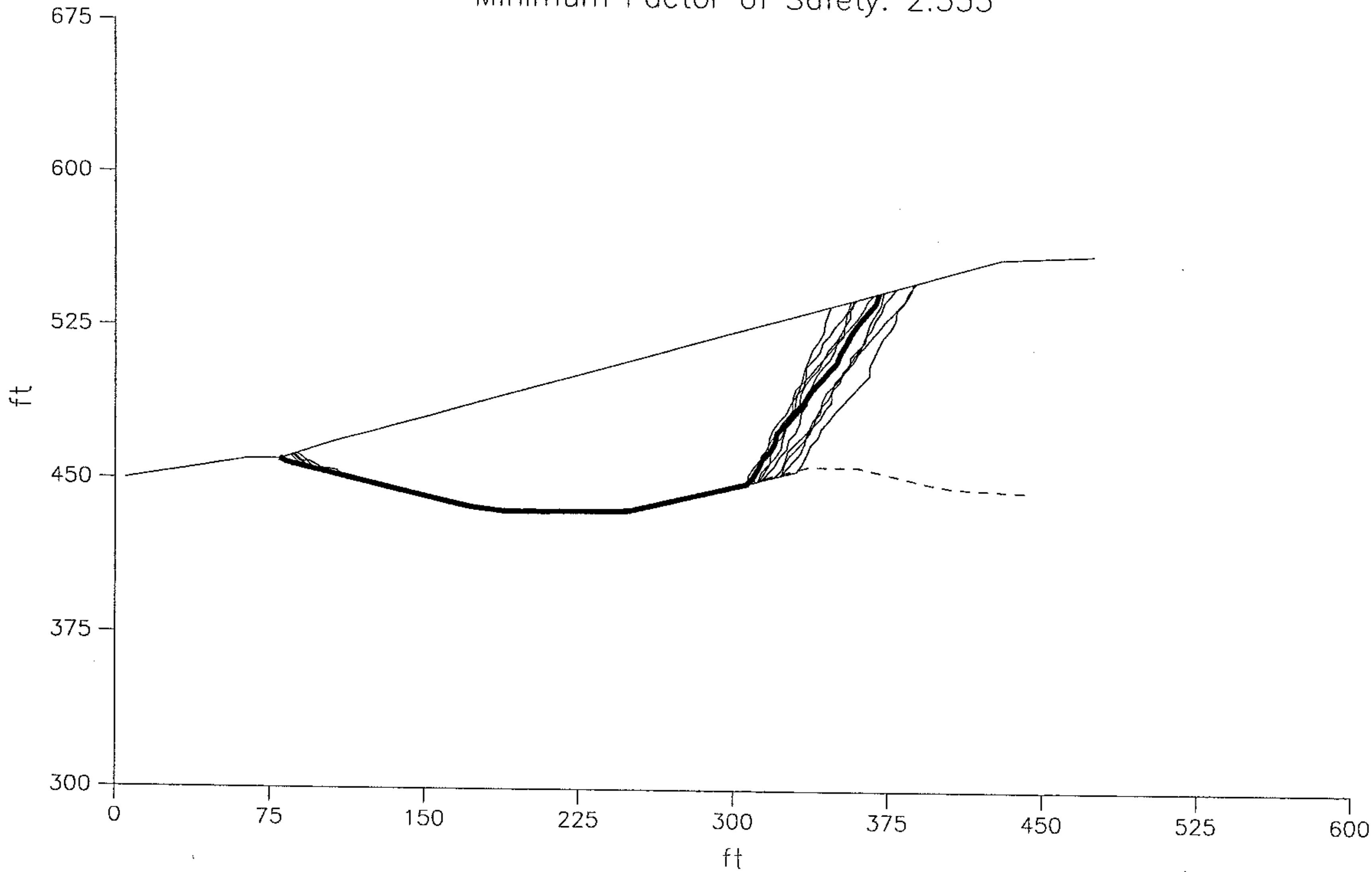


Cumberland Geotechnical Consultants, Inc. Carlisle, PA 17013

Title: Section A-A'
Description: Block Analysis

Block Surfaces - Most Critical Surfaces

Minimum Factor of Safety: 2.333



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*****************************************************************************
*****                          GeoSlope                                 *****
*****                         Version 5.50                              *****
*****                                                                   *****
*****            (c)1992-1996 by GEOCOMP Corp, Acton, MA                *****
*****      Licensed to Cumberland Geotechnical Consultants, Inc.        *****
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         File: C:\DOCUME~1\CGC\DESKTOP\GEOSLOPE\1647.dat
         Date: Thu 12-16-:4, 15:25:21
         Name: Prine Edward County Landfill - Cell C
Problem Title: Section A-A'
  Description: Block Analysis
      Remarks:
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*****************************************************************************
*****                          INPUT DATA                               *****
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Profile Boundaries

Number of Boundaries: 17
Number of Top Boundaries: 6

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	5.00	450.00	65.00	460.00	3
2	65.00	460.00	80.00	460.00	3
3	80.00	460.00	110.00	470.00	2
4	110.00	470.00	395.00	550.00	2
5	395.00	550.00	430.00	560.00	2
6	430.00	560.00	475.00	562.00	2
7	80.00	460.00	120.00	450.00	1
8	120.00	450.00	165.00	440.00	1
9	165.00	440.00	182.00	436.00	1
10	182.00	436.00	246.00	436.00	1
11	246.00	436.00	265.00	440.00	1
12	265.00	440.00	305.00	450.00	1
13	305.00	450.00	336.00	458.00	1
14	336.00	458.00	360.00	458.00	1
15	360.00	458.00	395.00	450.00	1
16	395.00	450.00	407.00	448.00	1
17	407.00	448.00	445.00	446.00	1

Soil Parameters

Number of Soil Types: 3

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	75.0	75.0	0.0	20.0	0.00	0.0	0
2	75.0	75.0	500.0	35.0	0.00	0.0	0
3	90.0	90.0	100.0	25.0	0.00	0.0	0

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*****                   TRIAL SURFACE GENERATION                        *****
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Data for Generating Sliding Block Surfaces

Number of Trial Surfaces: 20
Number of Boxes: 7
Segment Length: 5.00 ft

Box No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Height (ft)
1	80.00	459.00	119.00	449.00	0.00
2	120.00	449.00	164.00	439.00	0.00

3	165.00	439.0	181.00	435.00	0.00
4	182.00	435.00	245.00	435.00	0.00
5	246.00	435.00	264.00	439.00	0.00
6	265.00	439.00	304.00	449.00	0.00
7	305.00	449.00	335.00	457.00	0.00

****
*****   RESULTS   *****
****

Surface No.: 1
Factor of Safety: 2.333

	Soil	X (ft)	Y (ft)	Width (ft)	Weight (lb)	Load (lb)	Water (lb)	Normal (lb)	Shear (lb)
1	3	79.84	459.92	0.32	2.4	0.0	0.0	12.1	17.8
2	1	81.52	459.03	3.05	339.0	0.0	0.0	418.1	65.2
3	1	96.52	455.02	26.95	21206.0	0.0	0.0	22635.0	3531.8
4	1	115.00	450.63	10.00	15581.4	0.0	0.0	16631.5	2595.0
5	1	141.43	444.35	42.86	110828.2	0.0	0.0	118297.1	18458.1
6	1	163.93	439.02	2.14	7385.4	0.0	0.0	7831.1	1221.9
7	1	168.54	438.01	7.09	25741.3	0.0	0.0	27294.8	4258.9
8	1	177.04	436.58	9.91	38833.8	0.0	0.0	39972.0	6236.9
9	1	185.61	435.47	7.22	30184.6	0.0	0.0	31069.3	4847.8
10	1	217.61	435.20	56.78	276835.5	0.0	0.0	276538.3	43148.8
11	1	246.93	435.41	1.86	10186.1	0.0	0.0	10175.2	1587.7
12	1	256.43	437.48	17.14	94640.5	0.0	0.0	93825.5	14639.8
13	1	283.48	444.01	36.96	207027.5	0.0	0.0	205244.6	32024.7
14	1	303.48	448.78	3.04	17211.5	0.0	0.0	17019.3	2655.6
15	1	305.55	449.19	1.10	6264.0	0.0	0.0	6194.1	966.5
16	1	306.70	449.94	1.20	6762.5	0.0	0.0	8533.5	1331.5
17	2	308.40	451.78	2.19	12143.8	0.0	0.0	12949.2	4579.9
18	2	310.71	455.16	2.43	12960.0	0.0	0.0	16074.9	5897.0
19	2	312.98	459.60	2.13	10761.6	0.0	0.0	14038.1	5285.6
20	2	315.80	463.65	3.51	16886.5	0.0	0.0	17603.1	6355.8
21	2	318.75	467.62	2.38	10894.3	0.0	0.0	13441.9	5106.7
22	2	320.38	472.28	0.87	3703.1	0.0	0.0	5638.9	2764.4
23	2	322.57	476.52	3.51	14001.9	0.0	0.0	14450.3	5409.4
24	2	326.01	480.15	3.37	12763.0	0.0	0.0	13363.0	5083.0
25	2	329.33	483.89	3.26	11669.8	0.0	0.0	12336.5	4774.9
26	2	332.53	487.73	3.14	10549.5	0.0	0.0	11268.7	4454.3
27	2	335.36	491.83	2.52	7832.6	0.0	0.0	9047.8	3787.7
28	2	338.21	495.92	3.17	9060.6	0.0	0.0	9507.1	3925.5
29	2	341.49	499.70	3.39	8965.4	0.0	0.0	9102.3	3804.0
30	2	344.78	503.46	3.19	7766.8	0.0	0.0	7984.3	3468.4
31	2	348.11	507.18	3.48	7750.6	0.0	0.0	7654.8	3369.5
32	2	350.74	511.31	1.77	3485.2	0.0	0.0	3912.5	2246.2
33	2	352.99	515.74	2.73	4607.3	0.0	0.0	4648.3	2467.0
34	2	355.46	520.08	2.19	3095.3	0.0	0.0	3010.0	1975.3
35	2	357.93	524.41	2.75	3134.6	0.0	0.0	2795.8	1911.0
36	2	360.82	528.49	3.02	2702.1	0.0	0.0	2190.7	1729.3
37	2	363.96	532.37	3.27	2186.0	0.0	0.0	1560.9	1540.3
38	2	367.28	536.12	3.36	1536.1	0.0	0.0	830.0	1320.9
39	2	369.71	540.35	1.51	289.2	0.0	0.0	-1243.8	698.4
40	2	370.50	542.93	0.07	1.0	0.0	0.0	-179.9	32.6

Resultant Forces

	X	Y	R	Angle
Weight, lb :	0.00	-1047776.22	1047776.22	-90.00
Earthquake Load, lb :	0.00	0.00	0.00	0.00
Surcharge Load, lb :	0.00	0.00	0.00	0.00
Top Water, lb :	0.00	0.00	0.00	0.00
Bottom Water, lb :	0.00	0.00	0.00	0.00
Normal Force, lb :	-182363.28	977481.74	994347.49	100.57
Shear Force, lb :	182386.06	70294.48	195463.52	21.08

Surface No.: 2
Factor of Safety: 2.334

	Soil	X (ft)	Y (ft)	Width (ft)	Weight (lb)	Load (lb)	Water (lb)	Normal (lb)	Shear (lb)
1	2	88.45	460.61	3.40	562.8	0.0	0.0	2467.7	1752.2
2	2	91.20	457.96	2.08	900.7	0.0	0.0	2644.9	1416.7
3	1	92.98	456.21	1.50	910.2	0.0	0.0	1501.9	234.2
4	1	101.87	453.57	16.27	16742.0	0.0	0.0	17851.9	2783.9
5	1	115.00	450.48	10.00	15691.1	0.0	0.0	16731.3	2609.2

5	1	141.43	444.35	42.8	.0828.2	0.0	0.0	119094.0	2181
6	1	163.93	439.02	2.14	7385.4	0.0	0.0	7879.8	1443.2
7	1	168.54	438.01	7.09	25741.3	0.0	0.0	27464.6	5030.3
8	1	177.04	436.58	9.91	38833.8	0.0	0.0	40116.5	7347.6
9	1	185.61	435.47	7.22	30184.6	0.0	0.0	31181.6	5711.1
10	1	217.61	435.20	56.78	276835.5	0.0	0.0	276485.5	50640.0
11	1	246.93	435.41	1.86	10186.1	0.0	0.0	10173.3	1863.3
12	1	256.43	437.48	17.14	94640.5	0.0	0.0	93237.0	17076.9
13	1	283.48	444.01	36.96	207027.5	0.0	0.0	203957.3	37356.1
14	1	303.48	448.78	3.04	17211.5	0.0	0.0	16931.4	3101.1
15	1	305.55	449.19	1.10	6264.0	0.0	0.0	6162.1	1128.6
16	1	306.70	449.94	1.20	6762.5	0.0	0.0	8324.0	1524.6
17	2	308.40	451.78	2.19	12143.8	0.0	0.0	13228.1	4322.8
18	2	310.71	455.16	2.43	12960.0	0.0	0.0	16804.8	5491.7
19	2	312.98	459.60	2.13	10761.6	0.0	0.0	14913.3	4873.6
20	2	315.80	463.65	3.51	16886.5	0.0	0.0	18062.4	5902.7
21	2	318.75	467.62	2.38	10894.3	0.0	0.0	14263.8	4661.3
22	2	320.38	472.28	0.87	3703.1	0.0	0.0	7469.6	2441.0
23	2	322.57	476.52	3.51	14001.9	0.0	0.0	14973.2	4893.1
24	2	326.01	480.15	3.37	12763.0	0.0	0.0	13940.7	4555.7
25	2	329.33	483.89	3.26	11669.8	0.0	0.0	12962.0	4235.9
26	2	332.53	487.73	3.14	10549.5	0.0	0.0	11948.4	3904.6
27	2	335.36	491.83	2.52	7832.6	0.0	0.0	9960.3	3255.0
28	2	338.21	495.92	3.17	9060.6	0.0	0.0	10221.6	3340.4
29	2	341.49	499.70	3.39	8965.4	0.0	0.0	9766.8	3191.7
30	2	344.78	503.46	3.19	7766.8	0.0	0.0	8727.4	2852.1
31	2	348.11	507.18	3.48	7750.6	0.0	0.0	8323.4	2720.0
32	2	350.74	511.31	1.77	3485.2	0.0	0.0	5284.9	1727.1
33	2	352.99	515.74	2.73	4607.3	0.0	0.0	5615.8	1835.2
34	2	355.46	520.08	2.19	3095.3	0.0	0.0	4227.0	1381.4
35	2	357.93	524.41	2.75	3134.6	0.0	0.0	3806.8	1244.0
36	2	360.82	528.49	3.02	2702.1	0.0	0.0	3123.6	1020.8
37	2	363.96	532.37	3.27	2186.0	0.0	0.0	2425.8	792.7
38	2	367.28	536.12	3.36	1536.1	0.0	0.0	1681.3	549.5
39	2	369.71	540.35	1.51	289.2	0.0	0.0	471.0	153.9
40	2	370.50	542.93	0.07	1.0	0.0	0.0	2.0	0.7

Resultant Forces

	X	Y	R	Angle
Weight, lb :	0.00	-1047776.22	1047776.22	-90.00
Earthquake Load, lb :	0.00	0.00	0.00	0.00
Surcharge Load, lb :	0.00	0.00	0.00	0.00
Top Water, lb :	0.00	0.00	0.00	0.00
Bottom Water, lb :	0.00	0.00	0.00	0.00
Normal Force, lb :	-198458.64	987053.69	1006807.24	101.37
Shear Force, lb :	198508.23	60722.53	207587.92	17.01

Surface No.: 3
Factor of Safety: 1.991

	Soil	X (ft)	Y (ft)	Width (ft)	Weight (lb)	Load (lb)	Water (lb)	Normal (lb)	Shear (lb)
1	2	89.86	461.38	3.48	498.8	0.0	0.0	837.0	273.0
2	2	93.38	458.29	3.55	1644.4	0.0	0.0	3421.9	1116.2
3	2	95.52	456.28	0.74	494.9	0.0	0.0	764.3	249.3
4	1	97.60	454.88	3.41	2807.0	0.0	0.0	3858.2	705.4
5	1	101.76	453.26	4.91	5152.3	0.0	0.0	5436.9	994.0
6	1	107.11	452.10	5.79	7348.7	0.0	0.0	7895.4	1443.4
7	1	115.00	450.23	10.00	15879.2	0.0	0.0	17060.6	3119.0
8	1	122.21	448.52	4.42	8249.8	0.0	0.0	8863.6	1620.4
9	1	144.71	443.42	40.58	110554.2	0.0	0.0	118201.6	21609.6
10	1	168.14	438.14	6.27	22672.5	0.0	0.0	24240.9	4431.7
11	1	176.64	436.67	10.73	41860.3	0.0	0.0	43413.3	7936.8
12	1	185.17	435.45	6.34	26480.6	0.0	0.0	27463.0	5020.8
13	1	217.17	435.16	57.66	280735.8	0.0	0.0	280454.3	51272.7
14	1	246.74	435.33	1.48	8129.1	0.0	0.0	8120.9	1484.7
15	1	256.24	437.30	17.52	96884.0	0.0	0.0	95383.8	17438.1
16	1	269.45	440.28	8.90	49699.3	0.0	0.0	48929.8	8945.3
17	1	289.45	445.25	31.10	175244.1	0.0	0.0	172796.1	31590.6
18	1	314.07	451.52	18.13	103029.6	0.0	0.0	101590.4	18572.8
19	1	323.25	454.29	0.24	1347.1	0.0	0.0	3127.4	571.8
20	2	323.89	456.71	1.03	5675.4	0.0	0.0	9967.0	3251.2
21	2	325.52	460.91	2.23	11642.4	0.0	0.0	15773.9	5145.3
22	2	328.40	464.92	3.53	17590.5	0.0	0.0	18765.4	6121.2
23	2	331.82	468.56	3.30	15784.2	0.0	0.0	17429.9	5685.5
24	2	334.96	472.44	2.98	13574.2	0.0	0.0	15817.6	5159.6
25	2	337.58	476.68	2.27	9721.8	0.0	0.0	13067.4	4262.5
26	2	339.40	481.31	1.37	5453.7	0.0	0.0	9279.8	3027.0
27	2	341.36	485.87	2.56	9404.8	0.0	0.0	11883.8	3876.4

28	2	344.32	489.87	3.[illegible]	[illegible]1528.8	0.0	0.0	12641.4	412[illegible]
29	2	347.11	493.96	2.24	7161.3	0.0	0.0	9678.6	3157.1
30	2	349.88	498.08	3.30	9708.1	0.0	0.0	10731.3	3500.5
31	2	352.24	502.35	1.42	3797.3	0.0	0.0	6362.3	2075.3
32	2	354.55	506.67	3.21	7689.5	0.0	0.0	8625.0	2813.4
33	2	357.49	510.70	2.67	5770.6	0.0	0.0	7120.3	2322.6
34	2	360.42	514.74	3.18	6095.1	0.0	0.0	6865.6	2239.5
35	2	362.87	519.02	1.71	2820.8	0.0	0.0	4346.6	1417.8
36	2	365.30	523.30	3.16	4353.5	0.0	0.0	4919.1	1604.6
37	2	367.81	527.56	1.85	2052.2	0.0	0.0	3050.4	995.0
38	2	370.23	531.89	2.98	2495.9	0.0	0.0	2907.3	948.3
39	2	372.53	536.26	1.62	904.9	0.0	0.0	1428.9	466.1
40	2	374.97	540.53	3.25	939.8	0.0	0.0	1046.1	341.2
41	2	377.89	543.99	2.58	233.1	0.0	0.0	262.7	85.7

Resultant Forces

	X	Y	R	Angle
Weight, lb :	0.00	-1113109.77	1113109.77	-90.00
Earthquake Load, lb :	0.00	0.00	0.00	0.00
Surcharge Load, lb :	0.00	0.00	0.00	0.00
Top Water, lb :	0.00	0.00	0.00	0.00
Bottom Water, lb :	0.00	0.00	0.00	0.00
Normal Force, lb :	-207647.40	1052808.62	1073090.60	101.16
Shear Force, lb :	207702.56	60301.15	216278.94	16.19

Surface No.: 4
Factor of Safety: 2.076

	Soil	X (ft)	Y (ft)	Width (ft)	Weight (lb)	Load (lb)	Water (lb)	Normal (lb)	Shear (lb)
1	2	87.60	461.00	2.42	278.4	0.0	0.0	540.4	169.1
2	2	90.19	458.49	2.76	1016.6	0.0	0.0	2091.3	654.3
3	1	91.96	456.72	0.78	423.4	0.0	0.0	725.8	127.3
4	1	94.02	456.20	3.34	2122.9	0.0	0.0	2157.7	378.4
5	2	96.51	456.01	1.64	1169.8	0.0	0.0	1201.7	376.0
6	2	99.82	455.69	4.97	4071.5	0.0	0.0	4235.1	1325.1
7	2	104.78	455.03	4.94	4898.4	0.0	0.0	5220.2	1633.3
8	2	108.21	453.67	1.94	2287.2	0.0	0.0	4697.8	1469.9
9	1	109.59	452.30	0.82	1076.3	0.0	0.0	1843.0	323.2
10	1	110.39	451.50	0.78	1094.5	0.0	0.0	1874.2	328.7
11	1	115.39	450.06	9.22	14829.8	0.0	0.0	15841.0	2777.8
12	1	138.07	444.90	36.13	89376.7	0.0	0.0	95470.6	16741.6
13	1	160.57	439.80	8.87	29517.2	0.0	0.0	31458.5	5516.5
14	1	168.18	438.12	6.36	22988.5	0.0	0.0	24500.5	4296.4
15	1	174.42	437.24	6.13	23383.0	0.0	0.0	23657.2	4148.5
16	2	186.81	436.53	18.64	76917.0	0.0	0.0	78439.4	24542.1
17	1	204.90	435.50	17.56	80509.4	0.0	0.0	81453.4	14283.5
18	1	229.84	435.18	32.32	165933.4	0.0	0.0	165621.5	29043.1
19	1	246.85	435.37	1.70	9299.9	0.0	0.0	9282.4	1627.7
20	1	256.35	437.30	17.30	95741.8	0.0	0.0	94399.5	16553.7
21	1	268.32	439.96	6.64	37063.3	0.0	0.0	36543.7	6408.2
22	1	288.32	444.98	33.36	187862.1	0.0	0.0	185595.2	32545.6
23	1	317.66	452.50	25.31	143880.1	0.0	0.0	142143.9	24926.1
24	1	330.68	456.24	0.73	4155.2	0.0	0.0	5601.0	982.2
25	2	332.18	458.23	2.28	12662.2	0.0	0.0	14867.0	4651.6
26	2	334.39	462.00	2.13	11345.9	0.0	0.0	15996.3	5004.9
27	2	336.38	466.59	1.85	9288.7	0.0	0.0	14060.4	4399.2
28	2	339.02	470.72	3.44	16411.6	0.0	0.0	17927.9	5609.3
29	2	341.65	474.87	1.81	8154.4	0.0	0.0	12483.7	3905.9
30	2	344.21	479.08	3.31	14046.2	0.0	0.0	15680.4	4906.1
31	2	347.35	482.96	2.98	11974.9	0.0	0.0	14146.0	4426.0
32	2	350.60	486.74	3.54	13470.2	0.0	0.0	14509.9	4539.9
33	2	354.05	490.35	3.37	12152.8	0.0	0.0	13436.8	4204.1
34	2	357.46	494.01	3.45	11772.1	0.0	0.0	12838.5	4016.9
35	2	360.86	497.68	3.35	10723.7	0.0	0.0	11893.9	3721.4
36	2	364.28	501.33	3.49	10472.7	0.0	0.0	11363.8	3555.5
37	2	366.04	505.62	0.04	109.7	0.0	0.0	341.8	106.9
38	2	367.18	510.35	2.24	5341.7	0.0	0.0	7345.1	2298.1
39	2	369.37	514.85	2.14	4490.9	0.0	0.0	6315.4	1976.0
40	2	371.64	519.30	2.41	4354.9	0.0	0.0	5765.7	1804.0
41	2	374.51	523.36	3.32	5206.6	0.0	0.0	5795.0	1813.1
42	2	377.39	527.41	2.44	3232.7	0.0	0.0	4245.2	1328.2
43	2	378.90	532.07	0.58	578.7	0.0	0.0	1358.8	425.1
44	2	380.94	536.34	3.51	2558.3	0.0	0.0	2766.0	865.4
45	2	383.60	540.45	1.80	858.8	0.0	0.0	1316.2	411.8
46	2	386.02	544.76	3.05	621.4	0.0	0.0	724.5	226.7
47	2	388.19	547.51	1.28	55.9	0.0	0.0	63.3	19.8

Resultant Forces

	X	Y	R	Angle
Weight, lb :	0.00	-1169781.61	1169781.61	-90.00
Earthquake Load, lb :	0.00	0.00	0.00	0.00
Surcharge Load, lb :	0.00	0.00	0.00	0.00
Top Water, lb :	0.00	0.00	0.00	0.00
Bottom Water, lb :	0.00	0.00	0.00	0.00
Normal Force, lb :	-223705.18	1109438.12	1131767.18	101.40
Shear Force, lb :	223770.32	60343.49	231763.87	15.09

Surface No.: 5
Factor of Safety: 2.129

	Soil	X (ft)	Y (ft)	Width (ft)	Weight (lb)	Load (lb)	Water (lb)	Normal (lb)	Shear (lb)
1	2	87.61	460.38	3.33	537.7	0.0	0.0	1053.9	321.4
2	2	91.77	458.74	5.00	1945.4	0.0	0.0	1957.6	597.0
3	2	96.48	457.51	4.41	2641.3	0.0	0.0	3575.7	1090.5
4	2	99.56	455.61	1.75	1434.6	0.0	0.0	2478.6	755.9
5	1	101.49	454.02	2.11	2078.3	0.0	0.0	3130.4	535.1
6	1	104.97	452.57	4.86	5742.0	0.0	0.0	6166.8	1054.1
7	1	108.70	451.67	2.60	3483.8	0.0	0.0	3721.2	636.0
8	1	115.00	450.23	10.00	15883.5	0.0	0.0	16965.8	2899.9
9	1	133.31	446.01	26.61	60934.7	0.0	0.0	65086.7	11124.9
10	1	155.81	440.83	18.39	57958.3	0.0	0.0	61925.2	10584.6
11	1	172.62	436.95	15.24	57869.1	0.0	0.0	61829.9	10568.3
12	1	181.12	435.17	1.76	7232.6	0.0	0.0	7266.2	1242.0
13	1	184.89	435.07	5.78	24271.8	0.0	0.0	24384.4	4167.9
14	1	215.12	435.50	54.66	262400.9	0.0	0.0	261626.7	44718.5
15	2	244.39	436.04	3.89	20927.4	0.0	0.0	20814.8	6347.9
16	1	248.78	436.12	4.88	26682.9	0.0	0.0	26604.2	4547.3
17	1	258.11	437.83	13.78	76206.5	0.0	0.0	75290.2	12869.0
18	1	281.60	443.50	33.20	185928.7	0.0	0.0	183693.0	31397.7
19	1	301.60	448.35	6.80	38465.2	0.0	0.0	38010.6	6497.0
20	1	309.07	450.17	8.13	46168.7	0.0	0.0	45623.0	7798.1
21	1	313.66	451.77	1.06	5978.5	0.0	0.0	7581.6	1295.9
22	2	315.31	453.65	2.24	12449.2	0.0	0.0	13999.9	4269.5
23	2	318.16	456.73	3.45	18537.5	0.0	0.0	20362.3	6209.9
24	2	321.05	460.75	2.34	12025.4	0.0	0.0	16301.2	4971.4
25	2	323.91	464.80	3.39	16575.1	0.0	0.0	18380.3	5605.4
26	2	326.17	469.08	1.13	5222.8	0.0	0.0	9983.2	3044.6
27	2	328.35	473.42	3.22	13994.1	0.0	0.0	15939.5	4861.1
28	2	330.98	477.62	2.04	8328.3	0.0	0.0	12130.6	3699.5
29	2	332.32	482.38	0.64	2388.8	0.0	0.0	5557.8	1695.0
30	2	334.04	486.93	2.80	9641.5	0.0	0.0	11870.7	3620.2
31	2	335.61	491.50	0.35	1092.0	0.0	0.0	2921.1	890.8
32	2	336.92	496.21	2.28	6406.1	0.0	0.0	8809.2	2686.6
33	2	339.07	500.73	2.01	5067.6	0.0	0.0	7433.8	2267.1
34	2	341.61	504.99	3.07	6907.6	0.0	0.0	8085.0	2465.7
35	2	344.84	508.80	3.39	6888.6	0.0	0.0	7638.9	2329.6
36	2	347.75	512.83	2.44	4375.4	0.0	0.0	5801.8	1769.4
37	2	349.68	517.41	1.41	2108.5	0.0	0.0	3664.1	1117.5
38	2	352.09	521.63	3.41	4177.2	0.0	0.0	4614.2	1407.2
39	2	355.46	525.33	3.32	3382.8	0.0	0.0	3790.5	1156.0
40	2	358.72	529.12	3.20	2568.1	0.0	0.0	2937.3	895.8
41	2	361.67	533.14	2.70	1522.6	0.0	0.0	1909.3	582.3
42	2	364.18	537.46	2.30	671.5	0.0	0.0	918.2	280.0
43	2	366.59	541.03	2.53	189.1	0.0	0.0	208.6	63.6

Resultant Forces

	X	Y	R	Angle
Weight, lb :	0.00	-1049291.46	1049291.46	-90.00
Earthquake Load, lb :	0.00	0.00	0.00	0.00
Surcharge Load, lb :	0.00	0.00	0.00	0.00
Top Water, lb :	0.00	0.00	0.00	0.00
Bottom Water, lb :	0.00	0.00	0.00	0.00
Normal Force, lb :	-187430.71	997543.11	1014998.78	100.64
Shear Force, lb :	187550.12	51748.35	194558.31	15.43

Surface No.: 6
Factor of Safety: 2.194

	Soil	X (ft)	Y (ft)	Width (ft)	Weight (lb)	Load (lb)	Water (lb)	Normal (lb)	Shear (lb)
1	2	88.48	460.56	3.75	635.6	0.0	0.0	1138.2	336.9

2	2	91.39	457.91	2.[illegible]	917.8	0.0	0.0	1809.0	53[illegible]
3	1	93.18	456.16	1.49	922.1	0.0	0.0	1540.9	255.[illegible]
4	1	101.96	453.48	16.08	16691.1	0.0	0.0	17897.8	2969.4
5	1	115.00	450.31	10.00	15820.1	0.0	0.0	16963.9	2814.5
6	1	123.05	448.35	6.10	11571.8	0.0	0.0	12408.4	2058.7
7	1	145.55	443.27	38.90	107098.5	0.0	0.0	113953.8	18906.0
8	1	166.29	438.64	2.57	9104.8	0.0	0.0	9687.6	1607.3
9	1	174.79	437.17	14.43	55192.8	0.0	0.0	57497.7	9539.4
10	1	185.01	435.49	6.02	25082.8	0.0	0.0	26130.2	4335.3
11	1	217.01	435.40	57.98	281093.6	0.0	0.0	280482.5	46534.7
12	1	247.90	435.82	3.81	20822.0	0.0	0.0	20776.7	3447.0
13	1	257.40	437.68	15.19	83967.3	0.0	0.0	83051.6	13779.0
14	1	281.74	443.55	33.48	187459.7	0.0	0.0	185415.4	30762.2
15	1	301.74	448.34	6.52	36922.3	0.0	0.0	36498.5	6055.4
16	1	306.43	449.43	2.86	16225.7	0.0	0.0	16039.5	2661.1
17	1	308.12	450.32	0.53	3003.7	0.0	0.0	5170.1	857.8
18	2	309.20	452.57	1.62	8936.1	0.0	0.0	12795.8	3787.8
19	2	311.20	456.48	2.37	12430.6	0.0	0.0	16929.3	5011.4
20	2	312.85	461.13	0.94	4627.0	0.0	0.0	9674.5	2863.9
21	2	315.00	465.44	3.37	15681.9	0.0	0.0	17577.0	5203.2
22	2	316.97	469.77	0.57	2511.0	0.0	0.0	6141.4	1818.0
23	2	318.19	474.57	1.85	7482.5	0.0	0.0	11593.6	3431.9
24	2	320.60	478.90	2.98	11215.3	0.0	0.0	13457.1	3983.6
25	2	323.77	482.77	3.35	11871.1	0.0	0.0	13340.2	3949.0
26	2	326.55	486.86	2.22	7327.5	0.0	0.0	10320.8	3055.2
27	2	329.01	491.21	2.69	8110.0	0.0	0.0	10307.5	3051.3
28	2	332.04	495.16	3.38	9422.6	0.0	0.0	10537.6	3119.3
29	2	334.34	499.43	1.23	3083.2	0.0	0.0	5794.7	1715.3
30	2	334.97	504.35	0.03	67.9	0.0	0.0	224.7	66.5
31	2	336.66	508.71	3.34	6241.7	0.0	0.0	7025.9	2079.8
32	2	340.01	512.42	3.36	5580.7	0.0	0.0	6261.2	1853.5
33	2	342.43	516.66	1.47	2053.9	0.0	0.0	3555.7	1052.5
34	2	344.91	520.84	3.50	3964.7	0.0	0.0	4350.1	1287.7
35	2	347.96	524.76	2.60	2351.6	0.0	0.0	3040.2	900.0
36	2	350.99	528.70	3.46	2319.8	0.0	0.0	2563.0	758.7
37	2	354.09	532.60	2.73	1210.2	0.0	0.0	1525.0	451.4
38	2	356.22	537.01	1.54	243.0	0.0	0.0	407.5	120.6

Resultant Forces

	X	Y	R	Angle
Weight, lb :	0.00	-999263.76	999263.76	-90.00
Earthquake Load, lb :	0.00	0.00	0.00	0.00
Surcharge Load, lb :	0.00	0.00	0.00	0.00
Top Water, lb :	0.00	0.00	0.00	0.00
Bottom Water, lb :	0.00	0.00	0.00	0.00
Normal Force, lb :	-169443.40	953125.11	968069.49	100.08
Shear Force, lb :	169487.71	46138.66	175655.52	15.23

Surface No.: 7
Factor of Safety: 2.197

	Soil	X (ft)	Y (ft)	Width (ft)	Weight (lb)	Load (lb)	Water (lb)	Normal (lb)	Shear (lb)
1	3	79.41	459.61	1.17	41.7	0.0	0.0	109.2	87.5
2	1	81.01	458.53	2.02	273.5	0.0	0.0	371.2	61.5
3	1	84.50	457.53	4.96	1476.2	0.0	0.0	1520.9	252.0
4	1	98.49	454.46	23.02	20202.1	0.0	0.0	21625.0	3582.7
5	1	115.00	450.52	10.00	15661.6	0.0	0.0	16764.7	2777.5
6	1	134.32	445.91	28.63	66389.9	0.0	0.0	71066.1	11773.9
7	1	156.82	440.64	16.37	52177.3	0.0	0.0	55593.1	9210.4
8	1	169.78	437.69	9.56	35199.3	0.0	0.0	37503.7	6213.5
9	1	178.28	435.91	7.44	29713.0	0.0	0.0	31211.0	5170.9
10	1	182.55	435.10	1.10	4562.0	0.0	0.0	4792.0	793.9
11	1	203.82	435.50	41.44	189087.2	0.0	0.0	188389.1	31211.5
12	2	236.66	436.29	24.24	125891.5	0.0	0.0	125036.3	36961.3
13	1	251.22	436.64	4.88	26739.6	0.0	0.0	26640.9	4413.8
14	1	259.33	438.00	11.34	62858.1	0.0	0.0	62126.1	10292.8
15	1	270.23	440.49	10.47	58472.1	0.0	0.0	57791.1	9574.6
16	1	290.23	445.45	29.53	166451.8	0.0	0.0	164811.7	27305.3
17	1	313.66	451.41	17.33	98449.1	0.0	0.0	97479.1	16149.9
18	1	322.85	454.18	1.05	5969.5	0.0	0.0	7415.4	1228.5
19	2	324.56	456.01	2.37	13180.0	0.0	0.0	14648.2	4330.1
20	2	327.39	459.15	3.29	17707.4	0.0	0.0	20125.2	5949.1
21	2	330.69	462.91	3.32	17182.9	0.0	0.0	19420.4	5740.7
22	2	333.31	467.09	1.91	9404.6	0.0	0.0	14347.9	4241.3
23	2	334.83	471.83	1.14	5234.8	0.0	0.0	10152.2	3001.0
24	2	336.86	476.30	2.91	12527.4	0.0	0.0	15230.4	4502.2
25	2	340.03	480.15	3.44	14032.8	0.0	0.0	15553.7	4597.7
26	2	342.98	484.14	2.45	9426.0	0.0	0.0	12601.4	3725.0

27	2	345.84	488.21	3.2	1759.4	0.0	0.0	13405.3	396[illegible]
28	2	347.48	492.60	0.02	79.5	0.0	0.0	264.6	78.2
29	2	348.31	497.47	1.64	4835.4	0.0	0.0	7974.2	2357.2
30	2	350.84	501.65	3.43	9250.6	0.0	0.0	10265.9	3034.6
31	2	354.32	505.24	3.52	8807.6	0.0	0.0	9633.6	2847.7
32	2	356.36	509.50	0.55	1231.1	0.0	0.0	3043.5	899.7
33	2	358.39	513.76	3.52	6844.3	0.0	0.0	7494.6	2215.4
34	2	361.92	517.31	3.54	6206.3	0.0	0.0	6774.5	2002.6
35	2	364.18	521.53	0.98	1458.3	0.0	0.0	3000.2	886.9
36	2	365.47	526.34	1.61	1860.2	0.0	0.0	3087.0	912.5
37	2	367.57	530.85	2.58	2211.2	0.0	0.0	2877.2	850.5
38	2	370.21	535.10	2.70	1611.0	0.0	0.0	2040.4	603.2
39	2	372.02	539.66	0.92	267.4	0.0	0.0	564.3	166.8
40	2	372.81	542.99	0.66	38.6	0.0	0.0	61.3	18.1

Resultant Forces

	X	Y	R	Angle
Weight, lb :	0.00	-1114772.23	1114772.23	-90.00
Earthquake Load, lb :	0.00	0.00	0.00	0.00
Surcharge Load, lb :	0.00	0.00	0.00	0.00
Top Water, lb :	0.00	0.00	0.00	0.00
Bottom Water, lb :	0.00	0.00	0.00	0.00
Normal Force, lb :	-206158.98	1060223.18	1080080.88	101.00
Shear Force, lb :	206187.36	54549.05	213281.10	14.82

Surface No.: 8
Factor of Safety: 2.237

	Soil	X (ft)	Y (ft)	Width (ft)	Weight (lb)	Load (lb)	Water (lb)	Normal (lb)	Shear (lb)
1	2	88.05	460.63	3.18	488.7	0.0	0.0	936.5	271.9
2	2	90.68	458.09	2.09	855.2	0.0	0.0	1672.3	485.5
3	1	92.46	456.34	1.49	871.6	0.0	0.0	1451.1	236.1
4	1	101.60	453.64	16.79	17080.9	0.0	0.0	18245.2	2968.7
5	1	115.00	450.49	10.00	15686.8	0.0	0.0	16756.2	2726.4
6	1	139.65	444.69	39.30	99118.3	0.0	0.0	105875.0	17226.9
7	1	162.15	439.42	5.70	19346.0	0.0	0.0	20605.2	3352.7
8	1	170.18	437.59	10.36	38308.0	0.0	0.0	40801.4	6638.8
9	1	178.36	436.28	5.99	23785.5	0.0	0.0	23975.4	3901.0
10	2	183.12	436.08	3.53	14412.6	0.0	0.0	14608.5	4241.0
11	1	196.50	435.50	23.23	102398.6	0.0	0.0	103216.5	16794.3
12	1	227.06	435.43	37.89	191612.3	0.0	0.0	190959.1	31070.9
13	1	248.14	435.90	4.29	23442.6	0.0	0.0	23362.7	3801.3
14	1	257.64	437.62	14.71	81455.3	0.0	0.0	80547.9	13105.9
15	1	269.59	440.32	9.17	51250.0	0.0	0.0	50679.1	8246.0
16	1	289.59	445.23	30.83	173815.1	0.0	0.0	172181.1	28015.5
17	1	308.39	449.95	6.77	38460.7	0.0	0.0	38099.1	6199.1
18	1	311.94	451.32	0.34	1941.9	0.0	0.0	4126.0	671.3
19	2	312.73	453.69	1.24	6797.7	0.0	0.0	11488.3	3335.2
20	2	315.12	457.32	3.53	18605.1	0.0	0.0	20406.6	5924.3
21	2	318.56	460.95	3.35	16974.6	0.0	0.0	19174.9	5566.7
22	2	321.60	464.90	2.74	13235.9	0.0	0.0	16750.1	4862.7
23	2	323.34	469.46	0.73	3328.3	0.0	0.0	7668.0	2226.1
24	2	324.45	474.32	1.49	6249.3	0.0	0.0	10861.8	3153.3
25	2	325.21	479.21	0.03	106.1	0.0	0.0	358.7	104.1
26	2	326.89	483.56	3.34	11862.6	0.0	0.0	13412.6	3893.8
27	2	330.24	487.28	3.35	11207.4	0.0	0.0	12646.5	3671.4
28	2	332.29	491.60	0.74	2270.7	0.0	0.0	5213.6	1513.6
29	2	333.73	496.34	2.14	5839.0	0.0	0.0	8468.1	2458.4
30	2	336.23	500.65	2.87	7065.1	0.0	0.0	8709.0	2528.3
31	2	339.43	504.46	3.53	7936.6	0.0	0.0	8700.1	2525.7
32	2	342.18	508.53	1.97	3938.4	0.0	0.0	5958.6	1729.9
33	2	344.85	512.68	3.36	5855.0	0.0	0.0	6602.6	1916.8
34	2	348.18	516.40	3.31	5072.6	0.0	0.0	5770.0	1675.1
35	2	351.60	520.05	3.52	4695.7	0.0	0.0	5155.3	1496.7
36	2	353.57	524.32	0.41	437.2	0.0	0.0	1174.4	340.9
37	2	355.11	528.92	2.67	1979.7	0.0	0.0	2539.0	737.1
38	2	356.55	533.53	0.21	90.4	0.0	0.0	271.9	78.9
39	2	358.10	538.04	2.89	347.4	0.0	0.0	423.9	123.1

Resultant Forces

	X	Y	R	Angle
Weight, lb :	0.00	-1028224.96	1028224.96	-90.00
Earthquake Load, lb :	0.00	0.00	0.00	0.00
Surcharge Load, lb :	0.00	0.00	0.00	0.00

Top Water, lb :	0.	0.00	0.00	0.00
Bottom Water, lb :	0.00	0.00	0.00	0.00
Normal Force, lb :	-173798.96	982437.76	997692.35	100.03
Shear Force, lb :	173864.93	45787.20	179792.89	14.75

Surface No.: 9
Factor of Safety: 2.248

	Soil	X (ft)	Y (ft)	Width (ft)	Weight (lb)	Load (lb)	Water (lb)	Normal (lb)	Shear (lb)
1	2	86.66	460.10	3.26	517.2	0.0	0.0	998.9	288.6
2	2	89.04	458.04	1.50	558.8	0.0	0.0	821.4	237.3
3	1	91.14	456.68	2.69	1420.4	0.0	0.0	1894.8	306.8
4	1	101.24	453.66	17.52	17638.5	0.0	0.0	18908.6	3061.8
5	1	115.00	450.29	10.00	15836.9	0.0	0.0	16977.3	2749.1
6	1	121.82	448.62	3.64	6751.9	0.0	0.0	7238.2	1172.0
7	1	144.32	443.48	41.36	112139.4	0.0	0.0	119376.6	19330.2
8	1	169.60	437.74	9.20	33818.4	0.0	0.0	36000.9	5829.5
9	1	176.91	436.63	5.41	21145.7	0.0	0.0	21239.4	3439.2
10	2	190.73	436.28	22.23	93996.2	0.0	0.0	94718.2	27365.5
11	1	221.61	435.50	39.55	195247.8	0.0	0.0	196113.2	31756.0
12	1	243.69	435.35	4.61	24974.5	0.0	0.0	24654.4	3992.2
13	1	251.01	436.47	10.03	54995.4	0.0	0.0	54290.7	8791.1
14	1	260.51	438.21	8.97	49815.7	0.0	0.0	49250.9	7975.0
15	1	267.66	439.78	5.32	29719.8	0.0	0.0	29382.8	4757.9
16	1	287.66	444.69	34.68	195535.5	0.0	0.0	193704.2	31365.9
17	1	305.51	449.14	1.02	5781.5	0.0	0.0	5727.4	927.4
18	1	306.15	449.80	0.26	1461.0	0.0	0.0	3699.5	599.0
19	2	306.74	452.23	0.93	5087.9	0.0	0.0	9817.0	2836.3
20	2	308.63	456.18	2.84	14841.9	0.0	0.0	18402.9	5316.9
21	2	311.62	460.19	3.13	15585.9	0.0	0.0	18309.9	5290.0
22	2	314.48	464.28	2.59	12267.6	0.0	0.0	16028.4	4630.8
23	2	316.85	468.67	2.15	9574.9	0.0	0.0	13861.1	4004.7
24	2	319.34	472.99	2.84	11877.8	0.0	0.0	14742.2	4259.2
25	2	321.93	477.26	2.33	9137.1	0.0	0.0	12654.5	3656.1
26	2	324.69	481.40	3.18	11669.2	0.0	0.0	13575.8	3922.3
27	2	327.96	485.18	3.36	11587.0	0.0	0.0	13082.5	3779.7
28	2	329.98	489.50	0.69	2199.3	0.0	0.0	5175.5	1495.3
29	2	331.12	494.35	1.59	4489.0	0.0	0.0	7591.2	2193.2
30	2	332.63	499.12	1.43	3583.7	0.0	0.0	6363.7	1838.6
31	2	333.91	503.95	1.13	2448.6	0.0	0.0	4826.3	1394.4
32	2	335.45	508.69	1.94	3571.3	0.0	0.0	5464.2	1578.7
33	2	337.31	513.33	1.79	2756.7	0.0	0.0	4385.5	1267.0
34	2	339.74	517.64	3.06	3867.1	0.0	0.0	4601.2	1329.4
35	2	342.48	521.80	2.43	2454.4	0.0	0.0	3322.5	959.9
36	2	344.01	526.46	0.63	437.4	0.0	0.0	1059.1	306.0
37	2	345.19	531.29	1.73	612.8	0.0	0.0	993.9	287.2
38	2	346.60	535.10	1.08	106.8	0.0	0.0	172.8	49.9

Resultant Forces

	X	Y	R	Angle
Weight, lb :	0.00	-989510.76	989510.76	-90.00
Earthquake Load, lb :	0.00	0.00	0.00	0.00
Surcharge Load, lb :	0.00	0.00	0.00	0.00
Top Water, lb :	0.00	0.00	0.00	0.00
Bottom Water, lb :	0.00	0.00	0.00	0.00
Normal Force, lb :	-175505.74	942543.19	958743.93	100.55
Shear Force, lb :	175611.26	46967.57	181783.58	14.97

Surface No.: 10
Factor of Safety: 2.250

	Soil	X (ft)	Y (ft)	Width (ft)	Weight (lb)	Load (lb)	Water (lb)	Normal (lb)	Shear (lb)
1	2	91.43	462.70	1.66	138.2	0.0	0.0	274.6	79.3
2	2	94.11	460.19	3.71	1255.7	0.0	0.0	2286.3	660.0
3	2	98.22	457.43	4.49	2914.9	0.0	0.0	3773.5	1089.2
4	2	101.46	455.36	1.99	1759.4	0.0	0.0	3425.8	988.9
5	1	103.25	453.61	1.59	1683.3	0.0	0.0	2795.0	452.2
6	1	107.02	452.14	5.96	7540.6	0.0	0.0	8051.5	1302.6
7	1	115.00	450.26	10.00	15855.8	0.0	0.0	16930.1	2738.9
8	1	125.87	447.71	11.75	23565.0	0.0	0.0	25161.7	4070.6
9	1	148.37	442.57	33.25	95268.7	0.0	0.0	101380.3	16401.0
10	1	168.90	437.93	7.81	28465.4	0.0	0.0	30291.5	4900.5
11	1	175.58	436.95	5.55	21414.0	0.0	0.0	21546.5	3485.7
12	2	190.82	436.43	24.93	105194.7	0.0	0.0	106311.7	30686.7
13	1	217.83	435.50	29.09	141306.3	0.0	0.0	142180.5	23001.6
14	1	239.19	435.06	13.62	72744.7	0.0	0.0	72643.3	11752.0

15	1	246.28	435.12	0.5.	3108.6	0.0	0.0	3104.3	50.
16	1	255.78	437.28	18.43	101807.8	0.0	0.0	100742.9	16297.9
17	1	274.65	441.69	19.29	107823.0	0.0	0.0	106695.2	17260.9
18	1	294.65	446.50	20.71	117003.3	0.0	0.0	115885.2	18747.6
19	1	306.33	449.38	2.65	15070.7	0.0	0.0	14926.7	2414.8
20	1	307.78	450.23	0.25	1431.1	0.0	0.0	3637.7	588.5
21	2	308.37	452.66	0.93	5080.6	0.0	0.0	9832.8	2838.2
22	2	309.74	456.90	1.82	9419.0	0.0	0.0	14902.1	4301.5
23	2	312.38	461.03	3.46	17073.8	0.0	0.0	18960.5	5472.9
24	2	315.88	464.60	3.53	16742.6	0.0	0.0	18381.6	5305.8
25	2	318.97	468.49	2.65	11976.1	0.0	0.0	15444.7	4458.1
26	2	321.25	472.92	1.91	8066.7	0.0	0.0	12441.7	3591.3
27	2	323.91	477.06	3.41	13535.6	0.0	0.0	15165.0	4377.4
28	2	326.43	481.25	1.63	6044.1	0.0	0.0	10097.9	2914.7
29	2	328.51	485.77	2.55	8709.7	0.0	0.0	11489.8	3316.5
30	2	331.35	489.87	3.12	9894.1	0.0	0.0	11642.7	3360.6
31	2	334.42	493.82	3.02	8864.3	0.0	0.0	10634.0	3069.5
32	2	337.43	497.81	3.01	8132.6	0.0	0.0	9770.0	2820.1
33	2	340.70	501.58	3.53	8788.7	0.0	0.0	9651.2	2785.8
34	2	344.21	505.14	3.48	7988.9	0.0	0.0	8843.4	2552.6
35	2	347.65	508.77	3.40	7113.9	0.0	0.0	7984.7	2304.8
36	2	349.40	513.11	0.12	214.8	0.0	0.0	687.7	198.5
37	2	351.19	517.41	3.46	5258.7	0.0	0.0	5844.8	1687.1
38	2	353.33	521.68	0.82	1016.7	0.0	0.0	2269.8	655.2
39	2	353.95	526.64	0.44	388.8	0.0	0.0	1036.5	299.2
40	2	355.90	530.94	3.46	2098.1	0.0	0.0	2330.6	672.7
41	2	358.40	535.12	1.54	533.5	0.0	0.0	914.5	264.0
42	2	360.39	539.06	2.43	223.3	0.0	0.0	265.2	76.6

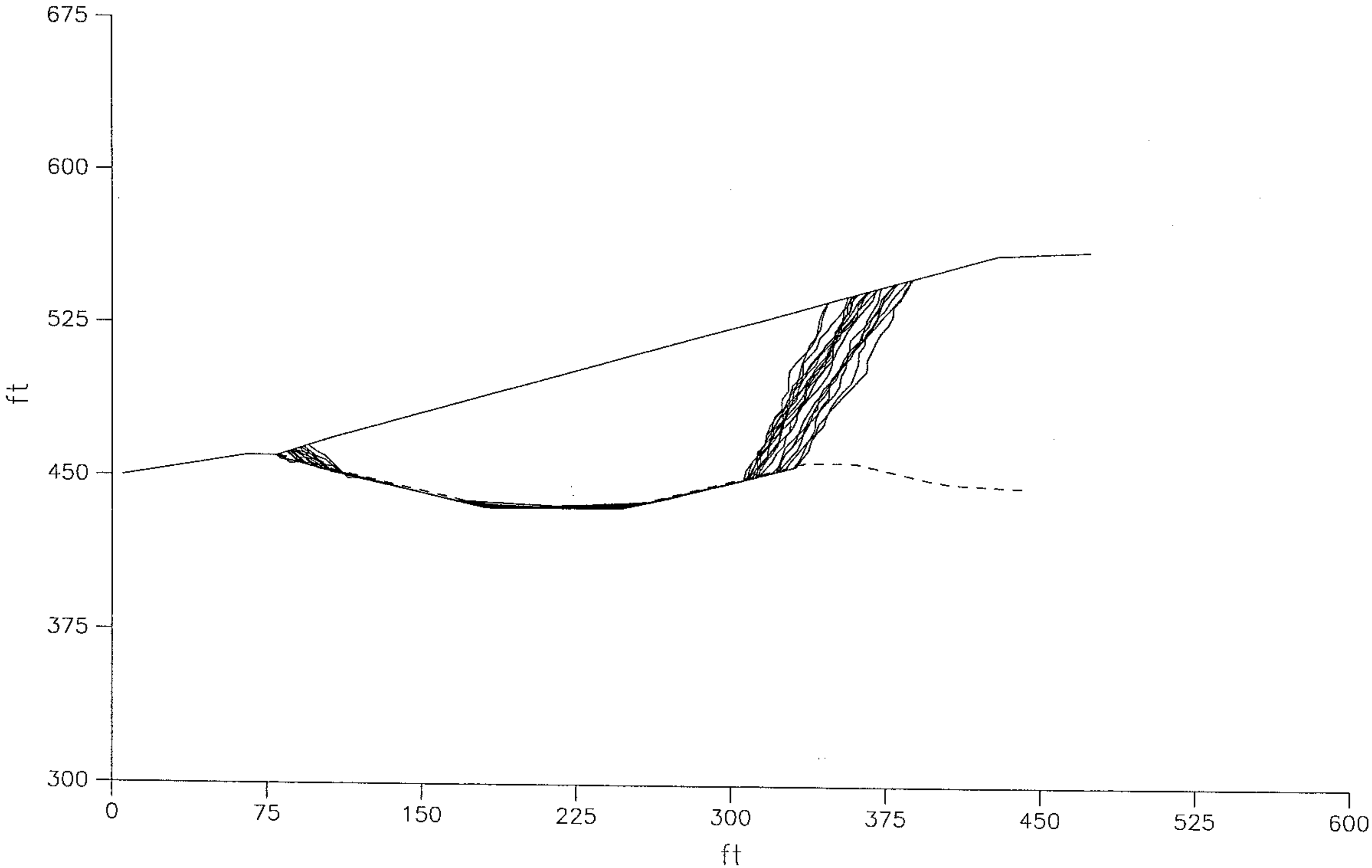
Resultant Forces

	X	Y	R	Angle
Weight, lb :	0.00	-1022515.73	1022515.73	-90.00
Earthquake Load, lb :	0.00	0.00	0.00	0.00
Surcharge Load, lb :	0.00	0.00	0.00	0.00
Top Water, lb :	0.00	0.00	0.00	0.00
Bottom Water, lb :	0.00	0.00	0.00	0.00
Normal Force, lb :	-185877.49	973262.57	990853.41	100.81
Shear Force, lb :	185970.60	49253.15	192382.26	14.83

Cumberland Geotechnical Consultants, Inc. Carlisle, PA 17013

Title: Section A-A'
Description: Block Analysis with reduced refuse strength

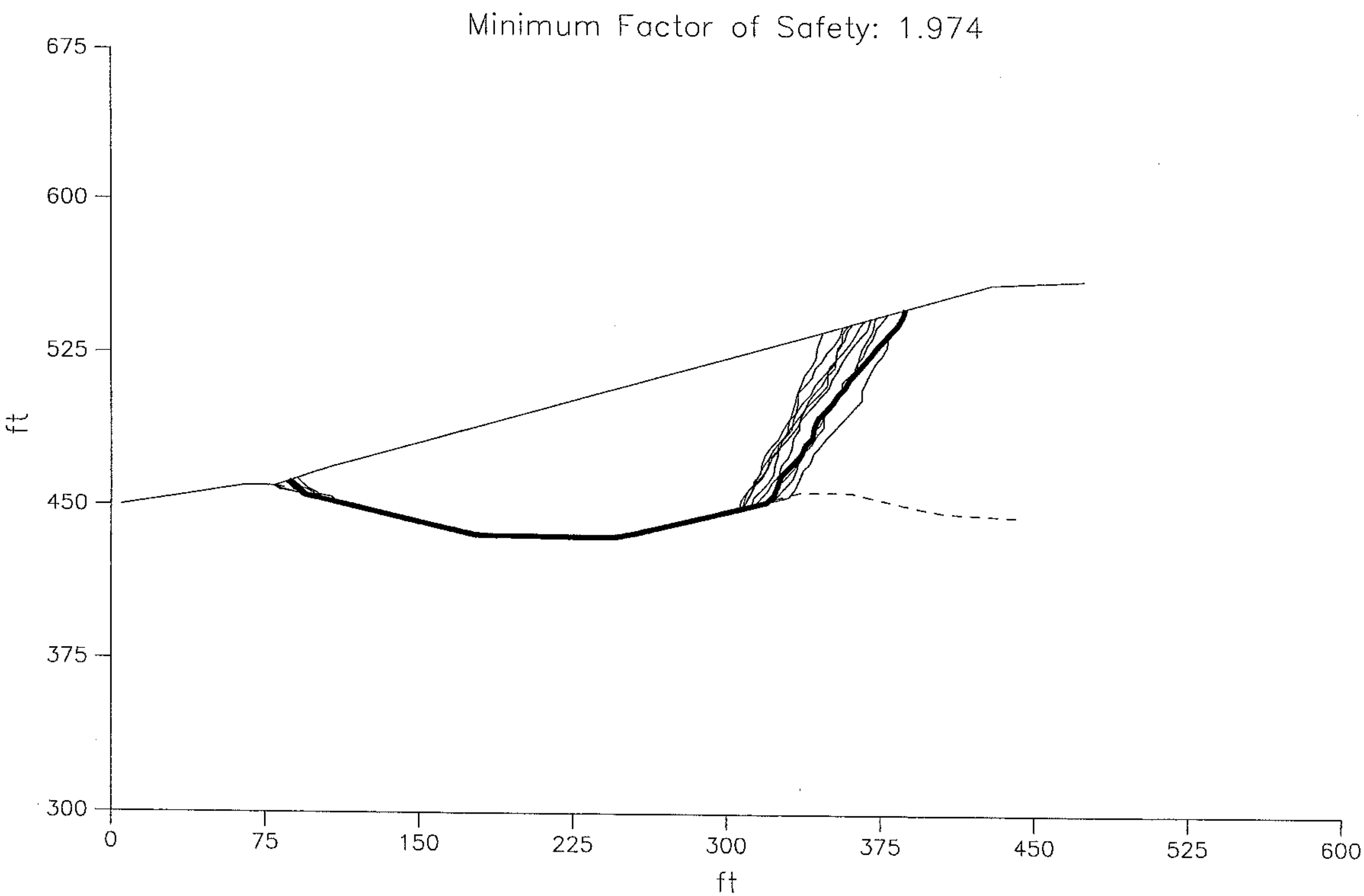
Block Surfaces - Search for Critical Surfaces



Cumberland Geotechnical Consultants, Inc. Carlisle, PA 17013

Title: Section A-A'
Description: Block Analysis with reduced refuse strength

Block Surfaces - Most Critical Surfaces



```
TITLE
Prine Edward County Landfill - Cell C
Section A-A'
Block Analysis with reduced refuse strength

UNITS
1 1 1 1
OPTIONS
3 4 3 1 1 1
1 1 0
PROFIL
17 6
5 450 65 460 3
65 460 80 460 3
80 460 110 470 2
110 470 395 550 2
395 550 430 560 2
430 560 475 562 2
80 460 120 450 1
120 450 165 440 1
165 440 182 436 1
182 436 246 436 1
246 436 265 440 1
265 440 305 450 1
305 450 336 458 1
336 458 360 458 1
360 458 395 450 1
395 450 407 448 1
407 448 445 446 1
SOIL
3
75 75 0 20 0 0 0
75 75 0 33 0 0 0
90 90 100 25 0 0 0
BLOCK
20 7 5
80 459 119 449 0
120 449 164 439 0
165 439 181 435 0
182 435 245 435 0
246 435 264 439 0
265 439 304 449 0
305 449 335 457 0
END
```

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*********************************************************************************
*****                               GeoSlope                               *****
*****                             Version 5.50                             *****
*****                                                                      *****
*****             (c)1992-1996 by GEOCOMP Corp, Acton, MA                  *****
*****      Licensed to Cumberland Geotechnical Consultants, Inc.           *****
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          File: C:\DOCUME~1\CGC\DESKTOP\GEOSLOPE\1647r.dat
          Date: Thu 12-16-:4, 15:29:35
          Name: Prine Edward County Landfill - Cell C
 Problem Title: Section A-A'
   Description: Block Analysis with reduced refuse strength
       Remarks:
```

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*********************************************************************************
*****                              INPUT DATA                              *****
*********************************************************************************
```

Profile Boundaries

Number of Boundaries: 17
Number of Top Boundaries: 6

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	5.00	450.00	65.00	460.00	3
2	65.00	460.00	80.00	460.00	3
3	80.00	460.00	110.00	470.00	2
4	110.00	470.00	395.00	550.00	2
5	395.00	550.00	430.00	560.00	2
6	430.00	560.00	475.00	562.00	2
7	80.00	460.00	120.00	450.00	1
8	120.00	450.00	165.00	440.00	1
9	165.00	440.00	182.00	436.00	1
10	182.00	436.00	246.00	436.00	1
11	246.00	436.00	265.00	440.00	1
12	265.00	440.00	305.00	450.00	1
13	305.00	450.00	336.00	458.00	1
14	336.00	458.00	360.00	458.00	1
15	360.00	458.00	395.00	450.00	1
16	395.00	450.00	407.00	448.00	1
17	407.00	448.00	445.00	446.00	1

Soil Parameters

Number of Soil Types: 3

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	75.0	75.0	0.0	20.0	0.00	0.0	0
2	75.0	75.0	0.0	33.0	0.00	0.0	0
3	90.0	90.0	100.0	25.0	0.00	0.0	0

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*********************************************************************************
*****                       TRIAL SURFACE GENERATION                       *****
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Data for Generating Sliding Block Surfaces

Number of Trial Surfaces: 20
Number of Boxes: 7
Segment Length: 5.00 ft

Box No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Height (ft)
1	80.00	459.00	119.00	449.00	0.00
2	120.00	449.00	164.00	439.00	0.00

3	165.00	439.00	181.00	435.00	0.00
4	182.00	435.00	245.00	435.00	0.00
5	246.00	435.00	264.00	439.00	0.00
6	265.00	439.00	304.00	449.00	0.00
7	305.00	449.00	335.00	457.00	0.00

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*****                             RESULTS                                 *****
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Surface No.: 1
Factor of Safety: 1.974

	Soil	X (ft)	Y (ft)	Width (ft)	Weight (lb)	Load (lb)	Water (lb)	Normal (lb)	Shear (lb)
1	2	88.45	460.61	3.40	562.8	0.0	0.0	1143.0	375.9
2	2	91.20	457.96	2.08	900.7	0.0	0.0	1856.8	610.7
3	1	92.98	456.21	1.50	910.2	0.0	0.0	1552.8	286.2
4	1	101.87	453.57	16.27	16742.0	0.0	0.0	17976.4	3313.7
5	1	115.00	450.48	10.00	15691.1	0.0	0.0	16848.0	3105.7
6	1	140.02	444.60	40.04	101562.0	0.0	0.0	109050.5	20102.0
7	1	162.52	439.33	4.96	16903.1	0.0	0.0	18121.0	3340.4
8	1	171.54	437.24	13.09	49121.5	0.0	0.0	52660.8	9707.3
9	1	180.04	435.71	3.91	15823.2	0.0	0.0	15856.0	2922.8
10	1	213.39	435.34	62.79	299864.6	0.0	0.0	300486.7	55390.6
11	1	245.39	435.12	1.21	6638.3	0.0	0.0	6528.7	1203.5
12	1	250.53	436.13	9.06	49801.1	0.0	0.0	48979.0	9028.6
13	1	260.03	438.22	9.94	55108.7	0.0	0.0	54280.2	10005.8
14	1	280.59	443.21	31.17	174576.5	0.0	0.0	171952.0	31697.0
15	1	300.59	448.10	8.83	49922.7	0.0	0.0	49197.4	9068.9
16	1	312.22	451.03	14.44	82026.8	0.0	0.0	80834.9	14900.8
17	1	320.03	453.44	1.17	6647.7	0.0	0.0	7949.5	1465.4
18	2	321.79	455.21	2.35	13109.0	0.0	0.0	13965.3	4593.2
19	2	323.88	458.72	1.81	9684.8	0.0	0.0	14482.2	4763.2
20	2	325.52	463.44	1.48	7446.9	0.0	0.0	12202.1	4013.2
21	2	328.01	467.62	3.50	16678.7	0.0	0.0	17846.3	5869.6
22	2	331.49	471.21	3.46	15814.2	0.0	0.0	17018.1	5597.2
23	2	334.88	474.88	3.32	14504.2	0.0	0.0	15938.6	5242.2
24	2	337.48	479.07	1.89	7773.4	0.0	0.0	11384.7	3744.4
25	2	340.19	483.16	3.52	13576.0	0.0	0.0	14484.5	4763.9
26	2	342.34	487.40	0.78	2788.1	0.0	0.0	5803.8	1908.8
27	2	343.76	492.15	2.07	6733.8	0.0	0.0	9449.1	3107.8
28	2	346.55	496.20	3.53	10635.2	0.0	0.0	11331.6	3726.9
29	2	350.02	499.80	3.40	9586.2	0.0	0.0	10403.7	3421.8
30	2	353.11	503.71	2.78	7192.6	0.0	0.0	8676.4	2853.7
31	2	356.22	507.61	3.44	8121.1	0.0	0.0	8767.6	2883.7
32	2	359.17	511.60	2.46	5234.5	0.0	0.0	6721.6	2210.7
33	2	362.12	515.59	3.44	6488.5	0.0	0.0	7005.9	2304.2
34	2	365.44	519.32	3.21	5390.2	0.0	0.0	6026.7	1982.2
35	2	368.69	523.12	3.30	4822.0	0.0	0.0	5317.9	1749.0
36	2	371.85	526.99	3.01	3725.5	0.0	0.0	4309.3	1417.3
37	2	375.12	530.76	3.53	3617.5	0.0	0.0	3852.0	1266.9
38	2	378.55	534.39	3.33	2748.3	0.0	0.0	3013.5	991.1
39	2	381.97	538.04	3.50	2179.3	0.0	0.0	2330.9	766.6
40	2	385.01	541.96	2.59	1017.1	0.0	0.0	1272.0	418.4
41	2	386.90	546.00	1.18	153.5	0.0	0.0	250.8	82.5

Resultant Forces

	X	Y	R	Angle
Weight, lb :	0.00	-1121823.15	1121823.15	-90.00
Earthquake Load, lb :	0.00	0.00	0.00	0.00
Surcharge Load, lb :	0.00	0.00	0.00	0.00
Top Water, lb :	0.00	0.00	0.00	0.00
Bottom Water, lb :	0.00	0.00	0.00	0.00
Normal Force, lb :	-213319.32	1058606.38	1079885.46	101.39
Shear Force, lb :	213371.95	63216.77	222539.77	16.50

Surface No.: 2
Factor of Safety: 1.987

	Soil	X (ft)	Y (ft)	Width (ft)	Weight (lb)	Load (lb)	Water (lb)	Normal (lb)	Shear (lb)
1	3	79.84	459.92	0.32	2.4	0.0	0.0	14.0	21.3
2	1	81.52	459.03	3.05	339.0	0.0	0.0	424.8	77.8
3	1	96.52	455.02	26.95	21206.0	0.0	0.0	22787.5	4173.7
4	1	115.00	450.63	10.00	15581.4	0.0	0.0	16743.5	3066.7

6	1	140.02	444.60	40.0	[illegible]1562.0	0.0	0.0	108295.4	1688[illegible]
7	1	162.52	439.33	4.96	16903.1	0.0	0.0	17997.7	2806.7
8	1	171.54	437.24	13.09	49121.5	0.0	0.0	52302.3	8156.3
9	1	180.04	435.71	3.91	15823.2	0.0	0.0	15851.1	2471.9
10	1	213.39	435.34	62.79	299864.6	0.0	0.0	300393.5	46845.2
11	1	245.39	435.12	1.21	6638.3	0.0	0.0	6564.0	1023.6
12	1	250.53	436.13	9.06	49801.1	0.0	0.0	49243.4	7679.3
13	1	260.03	438.22	9.94	55108.7	0.0	0.0	54640.6	8521.0
14	1	280.59	443.21	31.17	174576.5	0.0	0.0	173093.7	26993.3
15	1	300.59	448.10	8.83	49922.7	0.0	0.0	49535.7	7724.9
16	1	312.22	451.03	14.44	82026.8	0.0	0.0	81390.9	12692.6
17	1	320.03	453.44	1.17	6647.7	0.0	0.0	8145.5	1270.3
18	2	321.79	455.21	2.35	13109.0	0.0	0.0	13725.0	4832.4
19	2	323.88	458.72	1.81	9684.8	0.0	0.0	13534.2	5131.5
20	2	325.52	463.44	1.48	7446.9	0.0	0.0	11024.1	4378.5
21	2	328.01	467.62	3.50	16678.7	0.0	0.0	17411.9	6294.9
22	2	331.49	471.21	3.46	15814.2	0.0	0.0	16557.4	6038.5
23	2	334.88	474.88	3.32	14504.2	0.0	0.0	15424.7	5698.7
24	2	337.48	479.07	1.89	7773.4	0.0	0.0	10337.4	4172.5
25	2	340.19	483.16	3.52	13576.0	0.0	0.0	13978.5	5264.8
26	2	342.34	487.40	0.78	2788.1	0.0	0.0	3828.6	2219.8
27	2	343.76	492.15	2.07	6733.8	0.0	0.0	8390.1	3588.2
28	2	346.55	496.20	3.53	10635.2	0.0	0.0	10757.3	4298.5
29	2	350.02	499.80	3.40	9586.2	0.0	0.0	9776.4	4004.2
30	2	353.11	503.71	2.78	7192.6	0.0	0.0	7828.8	3419.9
31	2	356.22	507.61	3.44	8121.1	0.0	0.0	8111.5	3504.7
32	2	359.17	511.60	2.46	5234.5	0.0	0.0	5708.9	2783.9
33	2	362.12	515.59	3.44	6488.5	0.0	0.0	6308.7	2963.8
34	2	365.44	519.32	3.21	5390.2	0.0	0.0	5238.4	2642.7
35	2	368.69	523.12	3.30	4822.0	0.0	0.0	4538.6	2432.8
36	2	371.85	526.99	3.01	3725.5	0.0	0.0	3410.9	2094.4
37	2	375.12	530.76	3.53	3617.5	0.0	0.0	3112.3	2004.9
38	2	378.55	534.39	3.33	2748.3	0.0	0.0	2190.1	1728.2
39	2	381.97	538.04	3.50	2179.3	0.0	0.0	1547.0	1535.3
40	2	385.01	541.96	2.59	1017.1	0.0	0.0	130.4	1110.3
41	2	386.90	546.00	1.18	153.5	0.0	0.0	-1127.0	512.6

Resultant Forces

	X	Y	R	Angle
Weight, lb :	0.00	-1121823.15	1121823.15	-90.00
Earthquake Load, lb :	0.00	0.00	0.00	0.00
Surcharge Load, lb :	0.00	0.00	0.00	0.00
Top Water, lb :	0.00	0.00	0.00	0.00
Bottom Water, lb :	0.00	0.00	0.00	0.00
Normal Force, lb :	-196209.02	1051071.94	1069228.79	100.57
Shear Force, lb :	196325.87	70751.21	208685.36	19.82

Surface No.: 3
Factor of Safety: 2.350

	Soil	X (ft)	Y (ft)	Width (ft)	Weight (lb)	Load (lb)	Water (lb)	Normal (lb)	Shear (lb)
1	2	89.86	461.38	3.48	498.8	0.0	0.0	1737.8	1450.1
2	2	93.38	458.29	3.55	1644.4	0.0	0.0	4782.8	2489.1
3	2	95.52	456.28	0.74	494.9	0.0	0.0	906.3	460.2
4	1	97.60	454.88	3.41	2807.0	0.0	0.0	3777.2	585.1
5	1	101.76	453.26	4.91	5152.3	0.0	0.0	5406.9	837.5
6	1	107.11	452.10	5.79	7348.7	0.0	0.0	7841.1	1214.5
7	1	115.00	450.23	10.00	15879.2	0.0	0.0	16943.2	2624.4
8	1	122.21	448.52	4.42	8249.8	0.0	0.0	8802.6	1363.5
9	1	144.71	443.42	40.58	110554.2	0.0	0.0	117430.4	18189.0
10	1	168.14	438.14	6.27	22672.5	0.0	0.0	24082.7	3730.2
11	1	176.64	436.67	10.73	41860.3	0.0	0.0	43236.7	6697.0
12	1	185.17	435.45	6.34	26480.6	0.0	0.0	27351.3	4236.5
13	1	217.17	435.16	57.66	280735.8	0.0	0.0	280497.9	43446.9
14	1	246.74	435.33	1.48	8129.1	0.0	0.0	8122.2	1258.1
15	1	256.24	437.30	17.52	96884.0	0.0	0.0	95963.8	14864.0
16	1	269.45	440.28	8.90	49699.3	0.0	0.0	49227.3	7624.9
17	1	289.45	445.25	31.10	175244.1	0.0	0.0	173979.9	26948.1
18	1	314.07	451.52	18.13	103029.6	0.0	0.0	102286.3	15843.3
19	1	323.25	454.29	0.24	1347.1	0.0	0.0	3336.6	516.8
20	2	323.89	456.71	1.03	5675.4	0.0	0.0	8925.9	3524.5
21	2	325.52	460.91	2.23	11642.4	0.0	0.0	14996.9	5532.7
22	2	328.40	464.92	3.53	17590.5	0.0	0.0	18353.1	6532.8
23	2	331.82	468.56	3.30	15784.2	0.0	0.0	16944.3	6113.0
24	2	334.96	472.44	2.98	13574.2	0.0	0.0	15224.2	5600.4
25	2	337.58	476.68	2.27	9721.8	0.0	0.0	12205.2	4700.8
26	2	339.40	481.31	1.37	5453.7	0.0	0.0	7903.7	3419.1
27	2	341.36	485.87	2.56	9404.8	0.0	0.0	11067.4	4361.8

28	2	344.32	489.87	3.3	11528.8	0.0	0.0	12052.0	465
29	2	347.11	493.96	2.24	7161.3	0.0	0.0	8689.5	3653.2
30	2	349.88	498.08	3.30	9708.1	0.0	0.0	10083.6	4068.6
31	2	352.24	502.35	1.42	3797.3	0.0	0.0	4874.1	2516.3
32	2	354.55	506.67	3.21	7689.5	0.0	0.0	7901.2	3418.3
33	2	357.49	510.70	2.67	5770.6	0.0	0.0	6193.3	2909.4
34	2	360.42	514.74	3.18	6095.1	0.0	0.0	6090.2	2878.7
35	2	362.87	519.02	1.71	2820.8	0.0	0.0	2925.9	1935.8
36	2	365.30	523.30	3.16	4353.5	0.0	0.0	4088.8	2282.3
37	2	367.81	527.56	1.85	2052.2	0.0	0.0	1645.1	1554.1
38	2	370.23	531.89	2.98	2495.9	0.0	0.0	1964.7	1649.4
39	2	372.53	536.26	1.62	904.9	0.0	0.0	-166.9	1014.2
40	2	374.97	540.53	3.25	939.8	0.0	0.0	150.5	1108.8
41	2	377.89	543.99	2.58	233.1	0.0	0.0	-501.0	714.4

Resultant Forces

	X	Y	R	Angle
Weight, lb :	0.00	-1113109.77	1113109.77	-90.00
Earthquake Load, lb :	0.00	0.00	0.00	0.00
Surcharge Load, lb :	0.00	0.00	0.00	0.00
Top Water, lb :	0.00	0.00	0.00	0.00
Bottom Water, lb :	0.00	0.00	0.00	0.00
Normal Force, lb :	-189651.65	1046285.09	1063334.49	100.27
Shear Force, lb :	189673.10	66824.68	201100.53	19.41

Surface No.: 4
Factor of Safety: 2.520

	Soil	X (ft)	Y (ft)	Width (ft)	Weight (lb)	Load (lb)	Water (lb)	Normal (lb)	Shear (lb)
1	2	87.60	461.00	2.42	278.4	0.0	0.0	1350.5	1032.5
2	2	90.19	458.49	2.76	1016.6	0.0	0.0	3061.1	1624.5
3	1	91.96	456.72	0.78	423.4	0.0	0.0	699.6	101.0
4	1	94.02	456.20	3.34	2122.9	0.0	0.0	2152.5	310.9
5	2	96.51	456.01	1.64	1169.8	0.0	0.0	1223.8	667.0
6	2	99.82	455.69	4.97	4071.5	0.0	0.0	4327.4	2194.2
7	2	104.78	455.03	4.94	4898.4	0.0	0.0	5355.0	2479.7
8	2	108.21	453.67	1.94	2287.2	0.0	0.0	5220.4	1993.6
9	1	109.59	452.30	0.82	1076.3	0.0	0.0	1776.5	256.6
10	1	110.39	451.50	0.78	1094.5	0.0	0.0	1806.6	260.9
11	1	115.39	450.06	9.22	14829.8	0.0	0.0	15725.6	2271.0
12	1	138.07	444.90	36.13	89376.7	0.0	0.0	94775.5	13686.7
13	1	160.57	439.80	8.87	29517.2	0.0	0.0	31235.4	4510.8
14	1	168.18	438.12	6.36	22988.5	0.0	0.0	24326.7	3513.1
15	1	174.42	437.24	6.13	23383.0	0.0	0.0	23615.2	3410.3
16	2	186.81	436.53	18.64	76917.0	0.0	0.0	78494.6	25510.6
17	1	204.90	435.50	17.56	80509.4	0.0	0.0	81308.7	11742.0
18	1	229.84	435.18	32.32	165933.4	0.0	0.0	165678.3	23926.0
19	1	246.85	435.37	1.70	9299.9	0.0	0.0	9285.6	1340.9
20	1	256.35	437.30	17.30	95741.8	0.0	0.0	95029.1	13723.3
21	1	268.32	439.96	6.64	37063.3	0.0	0.0	36787.4	5312.5
22	1	288.32	444.98	33.36	187862.1	0.0	0.0	187015.5	27007.3
23	1	317.66	452.50	25.31	143880.1	0.0	0.0	143231.7	20684.4
24	1	330.68	456.24	0.73	4155.2	0.0	0.0	5794.0	836.7
25	2	332.18	458.23	2.28	12662.2	0.0	0.0	14644.5	4819.3
26	2	334.39	462.00	2.13	11345.9	0.0	0.0	15420.8	5276.1
27	2	336.38	466.59	1.85	9288.7	0.0	0.0	13322.3	4693.1
28	2	339.02	470.72	3.44	16411.6	0.0	0.0	17631.7	5890.4
29	2	341.65	474.87	1.81	8154.4	0.0	0.0	11650.9	4228.8
30	2	344.21	479.08	3.31	14046.2	0.0	0.0	15298.8	5242.2
31	2	347.35	482.96	2.98	11974.9	0.0	0.0	13658.9	4786.6
32	2	350.60	486.74	3.54	13470.2	0.0	0.0	14131.8	4918.0
33	2	354.05	490.35	3.37	12152.8	0.0	0.0	12998.3	4603.1
34	2	357.46	494.01	3.45	11772.1	0.0	0.0	12399.0	4436.6
35	2	360.86	497.68	3.35	10723.7	0.0	0.0	11405.9	4160.7
36	2	364.28	501.33	3.49	10472.7	0.0	0.0	10889.2	4017.2
37	2	366.04	505.62	0.04	109.7	0.0	0.0	-3085.9	134.6
38	2	367.18	510.35	2.24	5341.7	0.0	0.0	6401.2	2770.3
39	2	369.37	514.85	2.14	4490.9	0.0	0.0	5290.7	2461.8
40	2	371.64	519.30	2.41	4354.9	0.0	0.0	4810.1	2328.3
41	2	374.51	523.36	3.32	5206.6	0.0	0.0	5119.4	2414.2
42	2	377.39	527.41	2.44	3232.7	0.0	0.0	3238.7	1891.7
43	2	378.90	532.07	0.58	578.7	0.0	0.0	-1039.6	703.1
44	2	380.94	536.34	3.51	2558.3	0.0	0.0	2057.9	1563.7
45	2	383.60	540.45	1.80	858.8	0.0	0.0	-107.1	962.2
46	2	386.02	544.76	3.05	621.4	0.0	0.0	-198.7	936.7
47	2	388.19	547.51	1.28	55.9	0.0	0.0	-287.7	315.0

Resultant Forces

	X	Y	R	Angle
Weight, lb :	0.00	-1169781.61	1169781.61	-90.00
Earthquake Load, lb :	0.00	0.00	0.00	0.00
Surcharge Load, lb :	0.00	0.00	0.00	0.00
Top Water, lb :	0.00	0.00	0.00	0.00
Bottom Water, lb :	0.00	0.00	0.00	0.00
Normal Force, lb :	-206119.36	1105774.53	1124821.10	100.56
Shear Force, lb :	206146.27	64007.08	215854.56	17.25

Surface No.: 5
Factor of Safety: 2.574

	Soil	X (ft)	Y (ft)	Width (ft)	Weight (lb)	Load (lb)	Water (lb)	Normal (lb)	Shear (lb)
1	2	87.61	460.38	3.33	537.7	0.0	0.0	2173.9	1488.1
2	2	91.77	458.74	5.00	1945.4	0.0	0.0	1975.6	1508.8
3	2	96.48	457.51	4.41	2641.3	0.0	0.0	4108.6	2089.1
4	2	99.56	455.61	1.75	1434.6	0.0	0.0	2859.2	1218.8
5	1	101.49	454.02	2.11	2078.3	0.0	0.0	3044.4	430.5
6	1	104.97	452.57	4.86	5742.0	0.0	0.0	6120.8	865.6
7	1	108.70	451.67	2.60	3483.8	0.0	0.0	3695.1	522.5
8	1	115.00	450.23	10.00	15883.5	0.0	0.0	16846.7	2382.4
9	1	133.31	446.01	26.61	60934.7	0.0	0.0	64629.9	9139.7
10	1	155.81	440.83	18.39	57958.3	0.0	0.0	61489.2	8695.5
11	1	172.62	436.95	15.24	57869.1	0.0	0.0	61394.5	8682.2
12	1	181.12	435.17	1.76	7232.6	0.0	0.0	7260.7	1026.8
13	1	184.89	435.07	5.78	24271.8	0.0	0.0	24366.2	3445.8
14	1	215.12	435.50	54.66	262400.9	0.0	0.0	261767.5	37018.1
15	2	244.39	436.04	3.89	20927.4	0.0	0.0	20813.5	6418.7
16	1	248.78	436.12	4.88	26682.9	0.0	0.0	26618.5	3764.3
17	1	258.11	437.83	13.78	76206.5	0.0	0.0	75809.3	10720.6
18	1	281.60	443.50	33.20	185928.7	0.0	0.0	184959.7	26156.2
19	1	301.60	448.35	6.80	38465.2	0.0	0.0	38276.0	5412.8
20	1	309.07	450.17	8.13	46168.7	0.0	0.0	45941.6	6496.9
21	1	313.66	451.77	1.06	5978.5	0.0	0.0	7800.8	1103.2
22	2	315.31	453.65	2.24	12449.2	0.0	0.0	13826.6	4421.8
23	2	318.16	456.73	3.45	18537.5	0.0	0.0	20116.3	6444.1
24	2	321.05	460.75	2.34	12025.4	0.0	0.0	15759.0	5258.7
25	2	323.91	464.80	3.39	16575.1	0.0	0.0	18073.2	5888.3
26	2	326.17	469.08	1.13	5222.8	0.0	0.0	8708.3	3340.5
27	2	328.35	473.42	3.22	13994.1	0.0	0.0	15539.1	5198.9
28	2	330.98	477.62	2.04	8328.3	0.0	0.0	11335.1	4055.1
29	2	332.32	482.38	0.64	2388.8	0.0	0.0	3588.9	1947.7
30	2	334.04	486.93	2.80	9641.5	0.0	0.0	11257.5	4034.0
31	2	335.61	491.50	0.35	1092.0	0.0	0.0	360.8	1069.5
32	2	336.92	496.21	2.28	6406.1	0.0	0.0	7940.2	3131.5
33	2	339.07	500.73	2.01	5067.6	0.0	0.0	6412.9	2716.0
34	2	341.61	504.99	3.07	6907.6	0.0	0.0	7412.7	2988.0
35	2	344.84	508.80	3.39	6888.6	0.0	0.0	7035.5	2885.4
36	2	347.75	512.83	2.44	4375.4	0.0	0.0	4862.8	2294.3
37	2	349.68	517.41	1.41	2108.5	0.0	0.0	2163.8	1560.0
38	2	352.09	521.63	3.41	4177.2	0.0	0.0	3934.4	2041.7
39	2	355.46	525.33	3.32	3382.8	0.0	0.0	3061.6	1804.3
40	2	358.72	529.12	3.20	2568.1	0.0	0.0	2145.7	1555.1
41	2	361.67	533.14	2.70	1522.6	0.0	0.0	916.7	1220.7
42	2	364.18	537.46	2.30	671.5	0.0	0.0	-271.4	897.5
43	2	366.59	541.03	2.53	189.1	0.0	0.0	-380.7	615.8

Resultant Forces

	X	Y	R	Angle
Weight, lb :	0.00	-1049291.46	1049291.46	-90.00
Earthquake Load, lb :	0.00	0.00	0.00	0.00
Surcharge Load, lb :	0.00	0.00	0.00	0.00
Top Water, lb :	0.00	0.00	0.00	0.00
Bottom Water, lb :	0.00	0.00	0.00	0.00
Normal Force, lb :	-170070.13	992321.85	1006790.19	99.73
Shear Force, lb :	170123.62	56969.61	179408.98	18.51

Surface No.: 6
Factor of Safety: 2.651

	Soil	X (ft)	Y (ft)	Width (ft)	Weight (lb)	Load (lb)	Water (lb)	Normal (lb)	Shear (lb)
1	3	79.41	459.61	1.17	41.7	0.0	0.0	97.7	70.5

2	1	81.01	458.53	2.0	273.5	0.0	0.0	363.4	4.
3	1	84.50	457.53	4.96	1476.2	0.0	0.0	1515.2	208.1
4	1	98.49	454.46	23.02	20202.1	0.0	0.0	21473.6	2948.6
5	1	115.00	450.52	10.00	15661.6	0.0	0.0	16647.4	2285.9
6	1	134.32	445.91	28.63	66389.9	0.0	0.0	70568.6	9689.8
7	1	156.82	440.64	16.37	52177.3	0.0	0.0	55223.9	7582.8
8	1	169.78	437.69	9.56	35199.3	0.0	0.0	37254.6	5115.5
9	1	178.28	435.91	7.44	29713.0	0.0	0.0	31039.7	4262.1
10	1	182.55	435.10	1.10	4562.0	0.0	0.0	4765.7	654.4
11	1	203.82	435.50	41.44	189087.2	0.0	0.0	188517.6	25885.5
12	2	236.66	436.29	24.24	125891.5	0.0	0.0	125020.9	37598.2
13	1	251.22	436.64	4.88	26739.6	0.0	0.0	26659.0	3660.6
14	1	259.33	438.00	11.34	62858.1	0.0	0.0	62516.4	8584.2
15	1	270.23	440.49	10.47	58472.1	0.0	0.0	58154.2	7985.2
16	1	290.23	445.45	29.53	166451.8	0.0	0.0	165962.3	22788.4
17	1	313.66	451.41	17.33	98449.1	0.0	0.0	98159.7	13478.4
18	1	322.85	454.18	1.05	5969.5	0.0	0.0	7611.0	1045.1
19	2	324.56	456.01	2.37	13180.0	0.0	0.0	14488.4	4480.0
20	2	327.39	459.15	3.29	17707.4	0.0	0.0	19851.9	6187.2
21	2	330.69	462.91	3.32	17182.9	0.0	0.0	19131.6	5996.9
22	2	333.31	467.09	1.91	9404.6	0.0	0.0	13622.2	4541.6
23	2	334.83	471.83	1.14	5234.8	0.0	0.0	8899.7	3294.1
24	2	336.86	476.30	2.91	12527.4	0.0	0.0	14756.8	4841.3
25	2	340.03	480.15	3.44	14032.8	0.0	0.0	15178.8	4952.8
26	2	342.98	484.14	2.45	9426.0	0.0	0.0	11940.0	4097.2
27	2	345.84	488.21	3.27	11759.4	0.0	0.0	12942.7	4362.1
28	2	347.48	492.60	0.02	79.5	0.0	0.0	-3211.0	94.9
29	2	348.31	497.47	1.64	4835.4	0.0	0.0	6839.5	2749.9
30	2	350.84	501.65	3.43	9250.6	0.0	0.0	9751.9	3519.2
31	2	354.32	505.24	3.52	8807.6	0.0	0.0	9124.1	3353.4
32	2	356.36	509.50	0.55	1231.1	0.0	0.0	787.0	1151.0
33	2	358.39	513.76	3.52	6844.3	0.0	0.0	6929.8	2773.7
34	2	361.92	517.31	3.54	6206.3	0.0	0.0	6197.0	2580.1
35	2	364.18	521.53	0.98	1458.3	0.0	0.0	1171.9	1252.7
36	2	365.47	526.34	1.61	1860.2	0.0	0.0	1689.1	1389.3
37	2	367.57	530.85	2.58	2211.2	0.0	0.0	1891.7	1442.9
38	2	370.21	535.10	2.70	1611.0	0.0	0.0	1071.6	1226.2
39	2	372.02	539.66	0.92	267.4	0.0	0.0	-1489.1	549.8
40	2	372.81	542.99	0.66	38.6	0.0	0.0	-484.2	224.1

Resultant Forces

	X	Y	R	Angle
Weight, lb :	0.00	-1114772.23	1114772.23	-90.00
Earthquake Load, lb :	0.00	0.00	0.00	0.00
Surcharge Load, lb :	0.00	0.00	0.00	0.00
Top Water, lb :	0.00	0.00	0.00	0.00
Bottom Water, lb :	0.00	0.00	0.00	0.00
Normal Force, lb :	-187634.26	1054664.09	1071224.98	100.09
Shear Force, lb :	187714.65	60108.14	197103.47	17.76

Surface No.: 7
Factor of Safety: 2.652

	Soil	X (ft)	Y (ft)	Width (ft)	Weight (lb)	Load (lb)	Water (lb)	Normal (lb)	Shear (lb)
1	2	88.48	460.56	3.75	635.6	0.0	0.0	2161.9	1509.0
2	2	91.39	457.91	2.08	917.8	0.0	0.0	2457.1	1197.4
3	1	93.18	456.16	1.49	922.1	0.0	0.0	1491.0	204.6
4	1	101.96	453.48	16.08	16691.1	0.0	0.0	17768.9	2438.8
5	1	115.00	450.31	10.00	15820.1	0.0	0.0	16841.7	2311.5
6	1	123.05	448.35	6.10	11571.8	0.0	0.0	12319.1	1690.8
7	1	145.55	443.27	38.90	107098.5	0.0	0.0	113201.8	15537.0
8	1	166.29	438.64	2.57	9104.8	0.0	0.0	9623.6	1320.9
9	1	174.79	437.17	14.43	55192.8	0.0	0.0	57220.9	7853.6
10	1	185.01	435.49	6.02	25082.8	0.0	0.0	26004.5	3569.1
11	1	217.01	435.40	57.98	281093.6	0.0	0.0	280592.4	38511.5
12	1	247.90	435.82	3.81	20822.0	0.0	0.0	20784.8	2852.7
13	1	257.40	437.68	15.19	83967.3	0.0	0.0	83607.2	11475.1
14	1	281.74	443.55	33.48	187459.7	0.0	0.0	186655.9	25618.6
15	1	301.74	448.34	6.52	36922.3	0.0	0.0	36733.9	5041.7
16	1	306.43	449.43	2.86	16225.7	0.0	0.0	16142.9	2215.6
17	1	308.12	450.32	0.53	3003.7	0.0	0.0	5411.0	742.7
18	2	309.20	452.57	1.62	8936.1	0.0	0.0	12390.1	3981.7
19	2	311.20	456.48	2.37	12430.6	0.0	0.0	16428.7	5280.6
20	2	312.85	461.13	0.94	4627.0	0.0	0.0	8282.3	3129.6
21	2	315.00	465.44	3.37	15681.9	0.0	0.0	17252.9	5498.3
22	2	316.97	469.77	0.57	2511.0	0.0	0.0	4175.3	2045.2
23	2	318.19	474.57	1.85	7482.5	0.0	0.0	10730.7	3776.1
24	2	320.60	478.90	2.98	11215.3	0.0	0.0	12947.6	4361.5

25	2	323.77	482.77	3.[illegible]	11871.1	0.0	0.0	12897.9	434[illegible]
26	2	326.55	486.86	2.22	7327.5	0.0	0.0	9515.4	3455.2
27	2	329.01	491.21	2.69	8110.0	0.0	0.0	9626.9	3484.6
28	2	332.04	495.16	3.38	9422.6	0.0	0.0	10024.9	3589.7
29	2	334.34	499.43	1.23	3083.2	0.0	0.0	4329.2	2085.8
30	2	334.97	504.35	0.03	67.9	0.0	0.0	-3236.0	88.3
31	2	336.66	508.71	3.34	6241.7	0.0	0.0	6408.0	2634.7
32	2	340.01	512.42	3.36	5580.7	0.0	0.0	5627.6	2428.7
33	2	342.43	516.66	1.47	2053.9	0.0	0.0	2107.7	1499.2
34	2	344.91	520.84	3.50	3964.7	0.0	0.0	3704.2	1920.8
35	2	347.96	524.76	2.60	2351.6	0.0	0.0	2072.9	1490.1
36	2	350.99	528.70	3.46	2319.8	0.0	0.0	1857.7	1433.2
37	2	354.09	532.60	2.73	1210.2	0.0	0.0	547.8	1087.4
38	2	356.22	537.01	1.54	243.0	0.0	0.0	-1114.9	626.9

Resultant Forces

	X	Y	R	Angle
Weight, lb :	0.00	-999263.76	999263.76	-90.00
Earthquake Load, lb :	0.00	0.00	0.00	0.00
Surcharge Load, lb :	0.00	0.00	0.00	0.00
Top Water, lb :	0.00	0.00	0.00	0.00
Bottom Water, lb :	0.00	0.00	0.00	0.00
Normal Force, lb :	-150557.35	947886.87	959769.26	99.03
Shear Force, lb :	150668.24	51376.90	159187.01	18.83

Surface No.: 8
Factor of Safety: 2.735

	Soil	X (ft)	Y (ft)	Width (ft)	Weight (lb)	Load (lb)	Water (lb)	Normal (lb)	Shear (lb)
1	2	88.05	460.63	3.18	488.7	0.0	0.0	1915.1	1294.6
2	2	90.68	458.09	2.09	855.2	0.0	0.0	2294.7	1121.1
3	1	92.46	456.34	1.49	871.6	0.0	0.0	1402.8	186.7
4	1	101.60	453.64	16.79	17080.9	0.0	0.0	18114.0	2410.9
5	1	115.00	450.49	10.00	15686.8	0.0	0.0	16635.7	2214.1
6	1	139.65	444.69	39.30	99118.3	0.0	0.0	105113.6	13989.9
7	1	162.15	439.42	5.70	19346.0	0.0	0.0	20461.8	2723.3
8	1	170.18	437.59	10.36	38308.0	0.0	0.0	40517.6	5392.6
9	1	178.36	436.28	5.99	23785.5	0.0	0.0	23944.7	3186.9
10	2	183.12	436.08	3.53	14412.6	0.0	0.0	14614.9	4388.0
11	1	196.50	435.50	23.23	102398.6	0.0	0.0	103084.1	13719.8
12	1	227.06	435.43	37.89	191612.3	0.0	0.0	191086.5	25432.4
13	1	248.14	435.90	4.29	23442.6	0.0	0.0	23378.3	3111.5
14	1	257.64	437.62	14.71	81455.3	0.0	0.0	81071.4	10790.1
15	1	269.59	440.32	9.17	51250.0	0.0	0.0	51008.5	6788.9
16	1	289.59	445.23	30.83	173815.1	0.0	0.0	173421.8	23081.3
17	1	308.39	449.95	6.77	38460.7	0.0	0.0	38373.6	5107.3
18	1	311.94	451.32	0.34	1941.9	0.0	0.0	4387.9	584.0
19	2	312.73	453.69	1.24	6797.7	0.0	0.0	10942.1	3517.3
20	2	315.12	457.32	3.53	18605.1	0.0	0.0	20235.1	6095.3
21	2	318.56	460.95	3.35	16974.6	0.0	0.0	18952.8	5767.0
22	2	321.60	464.90	2.74	13235.9	0.0	0.0	16376.2	5107.2
23	2	323.34	469.46	0.73	3328.3	0.0	0.0	6057.7	2465.2
24	2	324.45	474.32	1.49	6249.3	0.0	0.0	9908.5	3451.2
25	2	325.21	479.21	0.03	106.1	0.0	0.0	-3089.2	123.2
26	2	326.89	483.56	3.34	11862.6	0.0	0.0	13019.0	4247.6
27	2	330.24	487.28	3.35	11207.4	0.0	0.0	12232.3	4046.2
28	2	332.29	491.60	0.74	2270.7	0.0	0.0	3402.6	1785.4
29	2	333.73	496.34	2.14	5839.0	0.0	0.0	7611.3	2863.0
30	2	336.23	500.65	2.87	7065.1	0.0	0.0	8064.8	2979.1
31	2	339.43	504.46	3.53	7936.6	0.0	0.0	8209.4	3016.2
32	2	342.18	508.53	1.97	3938.4	0.0	0.0	4922.0	2174.4
33	2	344.85	512.68	3.36	5855.0	0.0	0.0	6010.9	2453.3
34	2	348.18	516.40	3.31	5072.6	0.0	0.0	5140.3	2230.3
35	2	351.60	520.05	3.52	4695.7	0.0	0.0	4565.3	2083.1
36	2	353.57	524.32	0.41	437.2	0.0	0.0	-1401.3	555.4
37	2	355.11	528.92	2.67	1979.7	0.0	0.0	1607.7	1325.8
38	2	356.55	533.53	0.21	90.4	0.0	0.0	-2758.5	207.9
39	2	358.10	538.04	2.89	347.4	0.0	0.0	-488.8	779.6

Resultant Forces

	X	Y	R	Angle
Weight, lb :	0.00	-1028224.96	1028224.96	-90.00
Earthquake Load, lb :	0.00	0.00	0.00	0.00
Surcharge Load, lb :	0.00	0.00	0.00	0.00

	X	Y	R	Angle
Top Water, lb :	0.00	0.00	0.00	0.00
Bottom Water, lb :	0.00	0.00	0.00	0.00
Normal Force, lb :	-153350.59	978432.14	990376.62	98.91
Shear Force, lb :	153398.76	49792.82	161277.73	17.98

Surface No.: 9
Factor of Safety: 2.740

	Soil	X (ft)	Y (ft)	Width (ft)	Weight (lb)	Load (lb)	Water (lb)	Normal (lb)	Shear (lb)
1	2	86.66	460.10	3.26	517.2	0.0	0.0	2018.4	1342.4
2	2	89.04	458.04	1.50	558.8	0.0	0.0	1054.8	595.7
3	1	91.14	456.68	2.69	1420.4	0.0	0.0	1855.5	246.4
4	1	101.24	453.66	17.52	17638.5	0.0	0.0	18769.4	2492.8
5	1	115.00	450.29	10.00	15836.9	0.0	0.0	16852.3	2238.2
6	1	121.82	448.62	3.64	6751.9	0.0	0.0	7184.8	954.2
7	1	144.32	443.48	41.36	112139.4	0.0	0.0	118563.4	15746.9
8	1	169.60	437.74	9.20	33818.4	0.0	0.0	35755.7	4748.9
9	1	176.91	436.63	5.41	21145.7	0.0	0.0	21223.7	2818.8
10	2	190.73	436.28	22.23	93996.2	0.0	0.0	94741.0	28264.2
11	1	221.61	435.50	39.55	195247.8	0.0	0.0	195968.4	26027.4
12	1	243.69	435.35	4.61	24974.5	0.0	0.0	24761.5	3288.7
13	1	251.01	436.47	10.03	54995.4	0.0	0.0	54526.5	7241.9
14	1	260.51	438.21	8.97	49815.7	0.0	0.0	49556.5	6581.8
15	1	267.66	439.78	5.32	29719.8	0.0	0.0	29565.2	3926.7
16	1	287.66	444.69	34.68	195535.5	0.0	0.0	195066.2	25907.5
17	1	305.51	449.14	1.02	5781.5	0.0	0.0	5767.6	766.0
18	1	306.15	449.80	0.26	1461.0	0.0	0.0	3984.8	529.2
19	2	306.74	452.23	0.93	5087.9	0.0	0.0	9046.1	3024.9
20	2	308.63	456.18	2.84	14841.9	0.0	0.0	18088.8	5534.1
21	2	311.62	460.19	3.13	15585.9	0.0	0.0	18025.8	5518.0
22	2	314.48	464.28	2.59	12267.6	0.0	0.0	15591.0	4895.9
23	2	316.85	468.67	2.15	9574.9	0.0	0.0	13247.1	4297.0
24	2	319.34	472.99	2.84	11877.8	0.0	0.0	14298.2	4565.6
25	2	321.93	477.26	2.33	9137.1	0.0	0.0	12029.2	3985.8
26	2	324.69	481.40	3.18	11669.2	0.0	0.0	13151.6	4272.6
27	2	327.96	485.18	3.36	11587.0	0.0	0.0	12673.5	4150.5
28	2	329.98	489.50	0.69	2199.3	0.0	0.0	3306.9	1757.2
29	2	331.12	494.35	1.59	4489.0	0.0	0.0	6475.2	2566.7
30	2	332.63	499.12	1.43	3583.7	0.0	0.0	5101.6	2215.8
31	2	333.91	503.95	1.13	2448.6	0.0	0.0	3285.4	1751.7
32	2	335.45	508.69	1.94	3571.3	0.0	0.0	4383.8	2032.4
33	2	337.31	513.33	1.79	2756.7	0.0	0.0	3189.1	1727.1
34	2	339.74	517.64	3.06	3867.1	0.0	0.0	3864.2	1899.6
35	2	342.48	521.80	2.43	2454.4	0.0	0.0	2335.7	1509.1
36	2	344.01	526.46	0.63	437.4	0.0	0.0	-1230.6	597.8
37	2	345.19	531.29	1.73	612.8	0.0	0.0	-415.7	806.0
38	2	346.60	535.10	1.08	106.8	0.0	0.0	-730.0	383.7

Resultant Forces

	X	Y	R	Angle
Weight, lb :	0.00	-989510.76	989510.76	-90.00
Earthquake Load, lb :	0.00	0.00	0.00	0.00
Surcharge Load, lb :	0.00	0.00	0.00	0.00
Top Water, lb :	0.00	0.00	0.00	0.00
Bottom Water, lb :	0.00	0.00	0.00	0.00
Normal Force, lb :	-158453.25	937894.13	951184.96	99.59
Shear Force, lb :	158498.31	51616.63	166691.31	18.04

Surface No.: 10
Factor of Safety: 2.753

	Soil	X (ft)	Y (ft)	Width (ft)	Weight (lb)	Load (lb)	Water (lb)	Normal (lb)	Shear (lb)
1	2	81.48	460.03	1.28	45.0	0.0	0.0	163.2	292.2
2	2	82.33	459.57	0.42	38.4	0.0	0.0	209.1	160.4
3	1	84.13	457.83	3.17	842.3	0.0	0.0	1346.0	178.0
4	1	88.21	456.27	5.00	2423.9	0.0	0.0	2426.5	320.8
5	1	100.36	453.97	19.29	18538.2	0.0	0.0	19666.1	2600.4
6	1	115.00	450.50	10.00	15674.8	0.0	0.0	16628.4	2198.7
7	1	136.95	445.31	33.89	81984.5	0.0	0.0	86972.6	11500.1
8	1	159.45	440.02	11.11	36544.0	0.0	0.0	38674.2	5113.8
9	1	171.43	437.26	12.86	48221.9	0.0	0.0	51032.8	6747.9
10	1	179.93	435.75	4.14	16712.5	0.0	0.0	16748.7	2214.6
11	1	205.29	435.36	46.58	214460.8	0.0	0.0	214925.7	28418.9
12	1	233.45	435.50	9.75	50548.9	0.0	0.0	50134.1	6629.1
13	2	245.81	436.77	14.97	80106.7	0.0	0.0	78205.6	22627.1
14	1	257.12	437.93	7.65	42076.4	0.0	0.0	41731.2	5518.0

15	1	262.97	438.82	4.[illegible]	22559.8	0.0	0.0	22496.4	29[illegible]
16	1	277.84	442.45	25.6[illegible]	143753.9	0.0	0.0	143350.4	1895[illegible].8
17	1	297.84	447.36	14.33	80995.6	0.0	0.0	80798.5	10683.7
18	1	308.56	450.02	7.13	40474.0	0.0	0.0	40375.5	5338.7
19	1	312.47	451.46	0.69	3882.6	0.0	0.0	6097.5	806.3
20	2	313.78	453.59	1.93	10677.1	0.0	0.0	13642.9	4140.7
21	2	316.04	457.30	2.58	13643.6	0.0	0.0	17534.1	5368.5
22	2	317.70	461.91	0.75	3722.7	0.0	0.0	7043.3	2699.9
23	2	318.80	466.78	1.46	6766.7	0.0	0.0	11021.8	3711.9
24	2	321.29	470.95	3.50	15337.4	0.0	0.0	16649.1	5143.4
25	2	324.02	475.03	1.97	8137.8	0.0	0.0	11628.9	3866.4
26	2	326.16	479.55	2.30	8833.3	0.0	0.0	11693.1	3882.7
27	2	327.92	484.19	1.22	4290.6	0.0	0.0	6954.9	2677.4
28	2	328.56	489.12	0.06	186.4	0.0	0.0	-2711.9	218.4
29	2	329.37	493.99	1.56	4403.8	0.0	0.0	6390.8	2533.9
30	2	331.92	498.14	3.53	9050.2	0.0	0.0	9483.2	3320.5
31	2	335.42	501.71	3.46	8202.2	0.0	0.0	8612.7	3099.1
32	2	338.66	505.50	3.02	6498.2	0.0	0.0	7156.8	2728.8
33	2	341.89	509.30	3.45	6670.8	0.0	0.0	6880.4	2658.5
34	2	344.78	513.33	2.32	3933.2	0.0	0.0	4535.6	2062.0
35	2	347.64	517.37	3.40	4934.1	0.0	0.0	4923.8	2160.7
36	2	350.73	521.29	2.77	3384.3	0.0	0.0	3431.7	1781.2
37	2	353.14	525.65	2.04	1930.9	0.0	0.0	1719.6	1345.7
38	2	354.47	530.41	0.63	385.2	0.0	0.0	-1366.8	560.5
39	2	356.36	534.83	3.15	1019.7	0.0	0.0	379.7	1004.8
40	2	358.04	538.22	0.21	22.4	0.0	0.0	-1529.6	135.1

Resultant Forces

	X	Y	R	Angle
Weight, lb :	0.00	-1021915.19	1021915.19	-90.00
Earthquake Load, lb :	0.00	0.00	0.00	0.00
Surcharge Load, lb :	0.00	0.00	0.00	0.00
Top Water, lb :	0.00	0.00	0.00	0.00
Bottom Water, lb :	0.00	0.00	0.00	0.00
Normal Force, lb :	-158075.18	969341.73	982146.20	99.26
Shear Force, lb :	158201.11	52573.45	166708.00	18.38

ATTACHMENT VI
APPENDIX F-3

ATLANTIC GEOTECHNICAL SERVICES, INC.
10971 Richardson Road
Ashland, Virginia 23005
*Phone: (804) 550-2203 * FAX: (804) 550-2204*

PROJECT MEMORANDUM

DATE: November 17, 2000

TO: Jack Anders
Resource International, Ltd.

FROM: Michael O. Noggle, P.E.
Atlantic Geotechnical Services, Inc. (AGS)

COMMONWEALTH OF VIRGINIA
MICHAEL O. NOGGLE
NO. 019495
PROFESSIONAL ENGINEER

REFERENCE: Stability Analyses Results
Prince Edward County Landfill Closure
Prince Edward County, VA
AGS Project No. RG00-723
Resource PN: 90094.16

As requested, AGS performed stability analyses on the five (5) landfill sections using the material data provided by Resource. Slope stability analyses were performed using a computer aided slope stability program (STABL/G) developed originally by Purdue University as PC STABL5M.

Input Data

Five cross sections through the proposed landfill were provided by Resource. Material property data provided by Resource and used in our analyses is as follows:

Material Type	Unit Weight, pcf		Cohesion (c), psf	Angle of Internal Friction, °
	Moist	Saturated		
Waste	46.0	108.7	150	30
Soil	104.0	124.0	0	36

Cap and Liner Stability

Analyses were performed on the factor of safety against slippage between cap and liner layers. Based upon our review of the liner and cap slopes, it appears both range from about 3 to 4-horizontal to 1-vertical. Based upon simplified translational analyses, the following was calculated:

Materials	Range in Factor of Safety
Geotextiles to Soil	1.9 to 2.5
Geotextiles to Geomembrane	2.0 to 2.7
Geotextiles to Drainage Layer	1.7 to 2.3
Geomembrane to Clay Liner	1.4 to 1.9
Drainage Layer (Internal)	1.7 to 2.3
Clay Liner (Internal) *	1.4+ to 1.9+

*** Note:** **Does not consider cohesion component of soil strength which would increase the factor of safety.**

We hope this provides the information needed on this topic. Please call if you have any questions.

MON/eab

Attachments

RESOURCE

MEMORANDUM

TO: Mike Noggle
FROM: Jack Anders
DATE: 21 August 2000
RE: Prince Edward County Landfill
PN: 90094.16
CC:

As we discussed today, our initial plan was to perform the slope stability analysis, and have you provide a peer review. Since we have different computer programs, I understand that your analysis would essentially be duplicating our cross-sections in your program. Therefore, in order to make best use of our time and resources, I would like you to perform the stability analysis. I believe I need the following:

1. Both static and seismic analysis for all rotational and sliding wedge analysis. The coefficient of lateral acceleration is 0.21 (Algermissen). If we can justify using one-half to one-third of the peak coefficient, please cite. Use a reduced coefficient only if stability is unacceptable under full seismic conditions. Minimum FS=1.5 for static, and 1.2 for seismic.

2. Check the five sections I have noted on the attached materials. Note that Section 1 has a two-phase consideration. If any other section locations seem important to you, please evaluate them. If any sections can be disregarded, please note and do so.

3. Check both rotational mass failure, and sliding wedge failure. Check sliding wedge failure for the landfill mass sliding on the liner system, and for the cap system on the completed landfill. I have attached a base grade plot, and a mylar overlay showing 3:1 final grades (I'll need these returned.) I have also attached sketches of the liner and cap systems, cross-sections of the five locations previously described, and a list of material strength and design parameters.

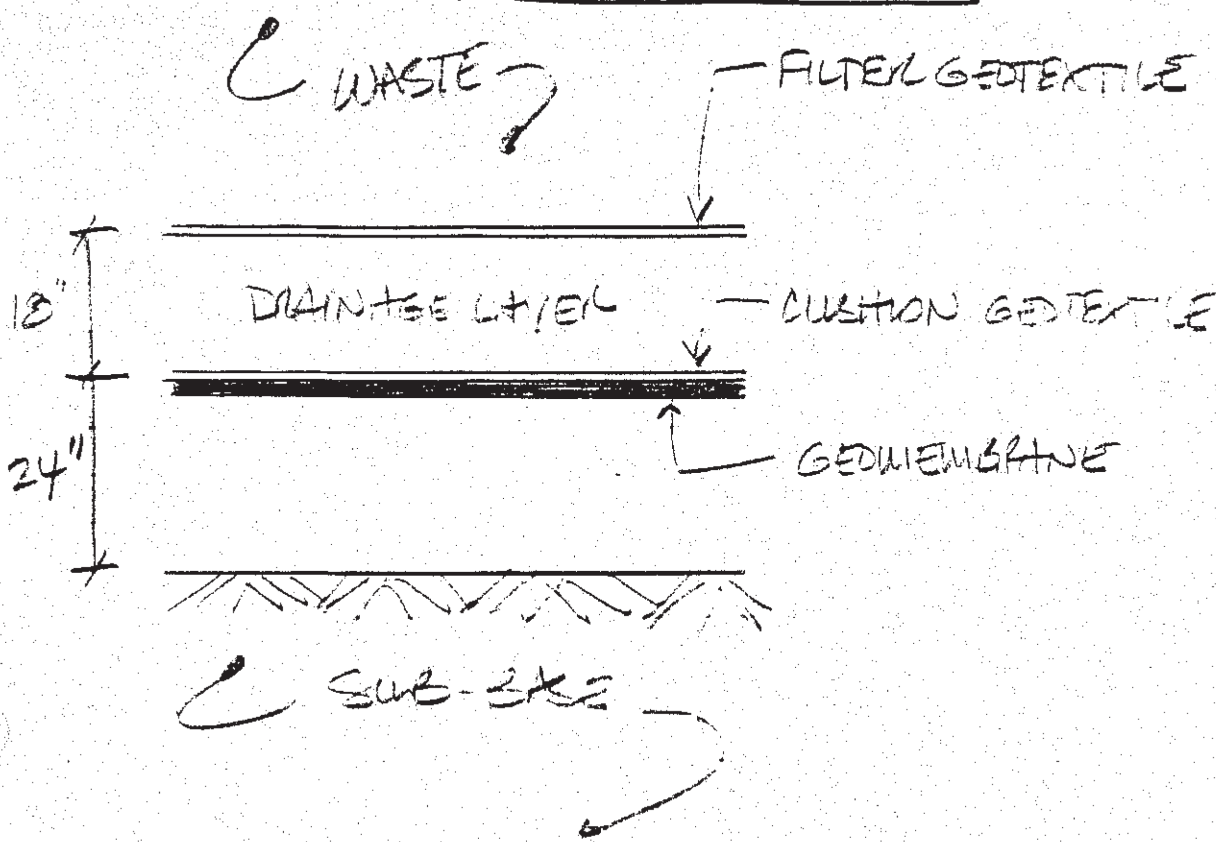
I would like to see this analysis as soon as possible, hopefully before the end of the month?

Please call me if there are any questions.

RESOURCE
INTERNATIONAL, LTD.
POST OFFICE BOX 6160
ASHLAND, VIRGINIA 23005
(804) 550-9200

JOB PRINCE EDWARD COUNTY LANDFILL
SHEET NO. 2 OF 3
CALCULATED BY JCA DATE 8/21/00
CHECKED BY DATE
SCALE 90094.16

LINER SECTION

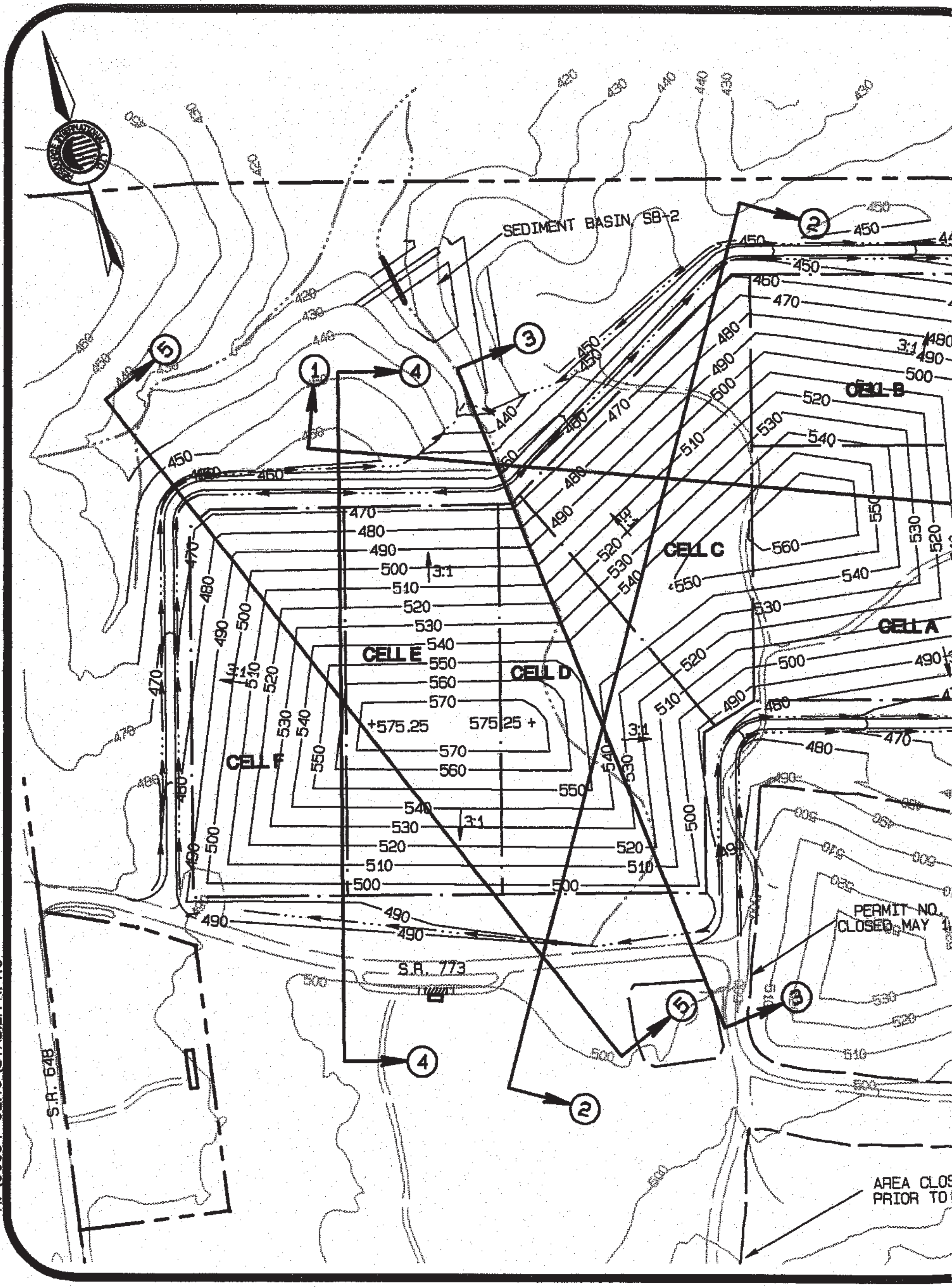


NOTES:

1. DRAINAGE LAYER IS SAND IN CELLS A&B; VDOT #68 STONE IN CELLS C,D,E&F.

2. NO CUSHION GEOTEXTILE IN CELLS A&B.

3. GEOMEMBRANE TEXTURED ON SIDESLOPES; SMOOTH ON FLATTER BOTTOM



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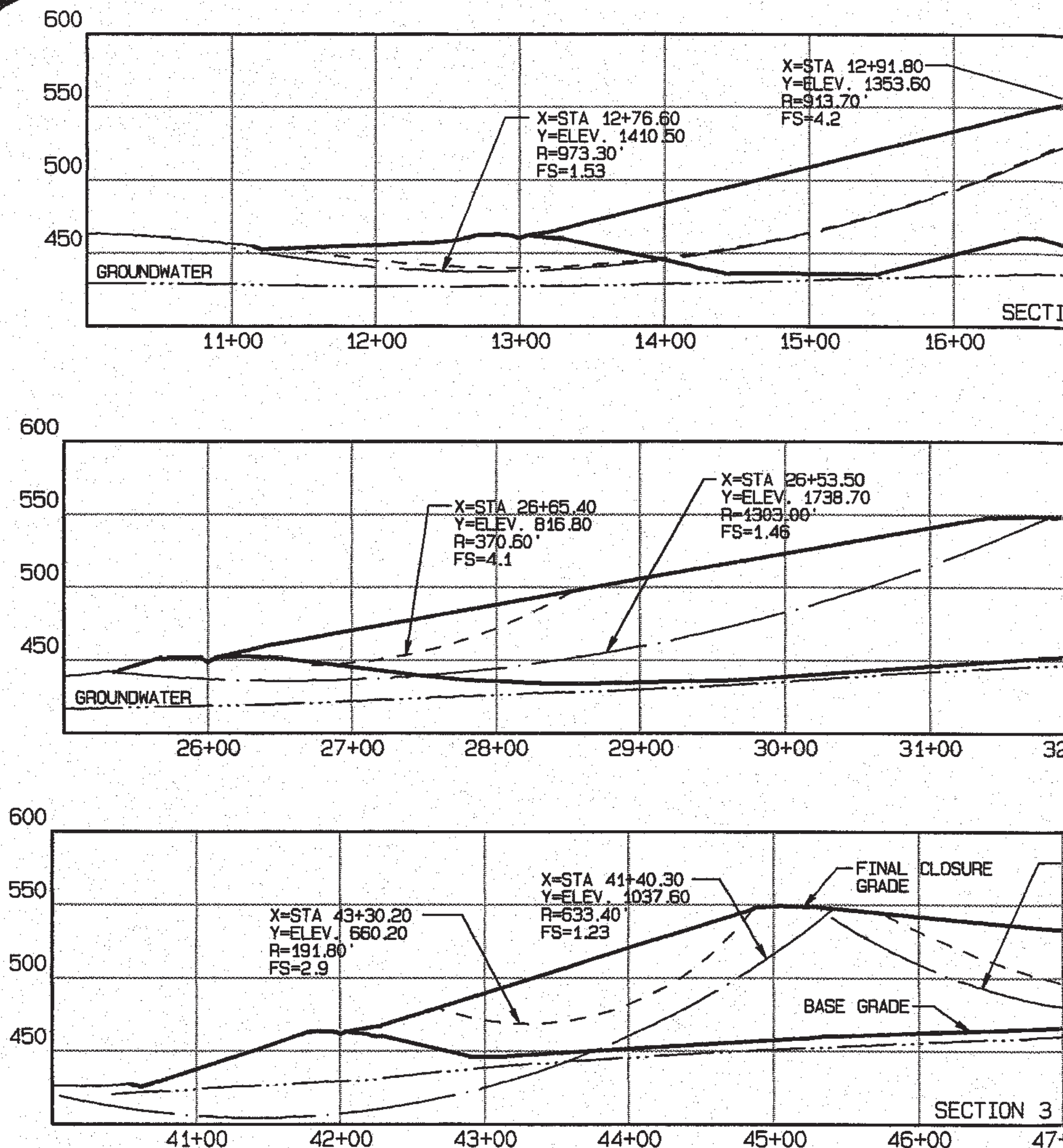

SCALE:
HORIZONTAL 1" = 100'
VERTICAL 1" = 100'

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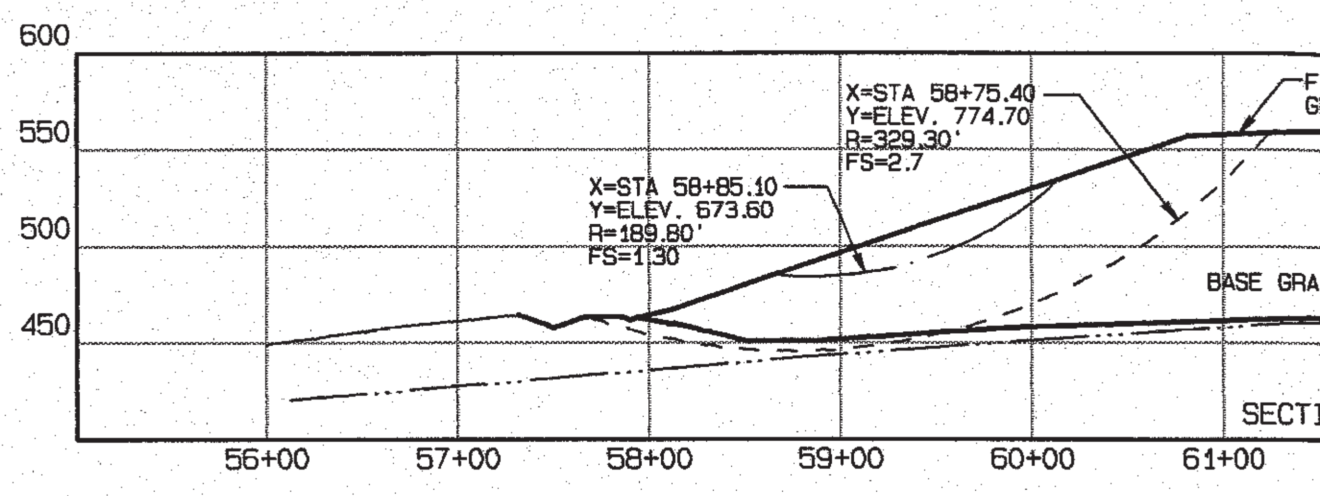

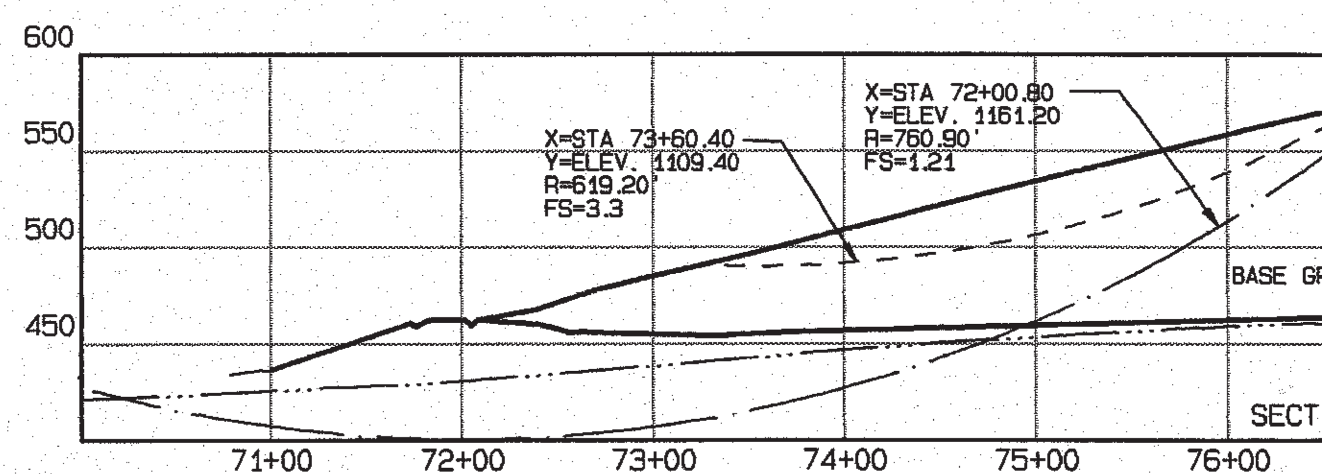

SCALE:
HORIZONTAL 1" = 100'
VERTICAL 1" = 100'

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APPENDIX 2-G

FACILITY LIFE ESTIMATE

Prince Edward County Sanitary Landfill

Life Estimate Calculations

Compaction Density 1,200 lbs/cy
Intake Rate 175 ton/day

Unit	Acreage (ac)	Gross Airspace Remaining (cy)	Liner (cy)*	Cap (cy)**	Daily Cover (cy) (2%)***	Waste Volume (cy)	Waste Volume (tons)	Cell Life (yrs)ł	
Cell E	3.46	206,568	0	19,537	4,131	182,899	109,740	2.0	
Cell F	3.44	391,802	8,325	19,425	7,836	356,217	213,730	3.9	
Total	6.90	598,370	8,325	38,962	11,967	539,116	323,469	5.9	11/15/2027

Compaction Density 1,200 lbs/cy
Intake Rate 225 ton/day

Unit	Acreage (ac)	Gross Airspace Remaining (cy)	Liner (cy)*	Cap (cy)**	Daily Cover (cy) (2%)***	Waste Volume (cy)	Waste Volume (tons)	Cell Life (yrs)ł	
Cell E	3.46	206,568	0	19,537	4,131	182,899	109,740	1.6	
Cell F	3.44	391,802	8,325	19,425	7,836	356,217	213,730	3.0	
Total	6.90	598,370	8,325	38,962	11,967	539,116	323,469	4.6	7/22/2026

Compaction Density 1,200 lbs/cy
Intake Rate 300 ton/day

Unit	Acreage (ac)	Gross Airspace Remaining (cy)	Liner (cy)*	Cap (cy)**	Daily Cover (cy) (2%)***	Waste Volume (cy)	Waste Volume (tons)	Cell Life (yrs)ł	
Cell E	3.46	206,568	0	19,537	4,131	182,899	109,739.50	1.2	
Cell F	3.44	391,802	8,325	19,425	7,836	356,217	213,730	2.3	
Total	6.90	598,370	8,325	38,962	11,967	539,116	323,469	3.5	5/28/2025

ł Life estimates are as of December 14, 2021
* Base liner is 1.5' thick
** Cap Section, not including intermediate cover is 3.5' thick
*** Daily cover includes the intermediate cover layer

Prince Edward County Landfill - Permit 584
Waste Generation Estimates

Year	*Gate Tons*	*Landfill Tons*	*Cummulative Landfill Tons*
1997	20,460	20,255	20,255
1998	20,580	20,374	40,630
1999	24,000	23,760	64,390
2000	29,200	28,908	93,298
2001	29,784	29,486	122,784
2002	30,380	30,076	152,860
2003	30,987	30,677	183,537
2004	31,607	31,291	214,828
2005	32,239	31,917	246,745
2006	32,884	32,555	279,300
2007	33,542	33,206	312,506
2008	34,212	33,870	346,376
2009	34,897	34,548	380,924
2010	35,595	35,239	416,163
2011	36,307	35,943	452,106
2012	37,033	36,662	488,769
2013	37,773	37,396	526,164
2014	38,529	38,143	564,308
2015	39,299	38,906	603,214
2016	40,085	39,684	642,899
2017	40,887	40,478	683,377
2018	41,705	41,288	724,664
2019	42,539	42,113	766,778
2020	43,390	42,956	809,734
2021	44,257	43,815	853,549
2022	45,143	44,691	898,240
2023	46,045	45,585	943,825
2024	46,966	46,497	990,322
2025	47,906	47,427	1,037,748

Rate of annual tonnage increase: 1.02

Rate of annual tonnage diversion: 0.01

APPENDIX 2-H

SOIL BALANCE AND DAILY CELL CALCULATIONS

Prince Edward County Sanitary Landfill
Calculations of working face size, daily cover soil volume, and site life for landfills

Calculations of working face size and daily cover soil volume

**NOTE: Please enter data only on the shaded areas as appropriate. Data entry (primary) Secondary

Assumptions:

1. Waste density, γ_d =	1,200	lbs/cy	=	0.60	tons/cy	γ_d	=	0.60 tons/cy
2. Waste lift height, D_w =		10	ft.			D_w	=	10 ft.
3. Daily cover thickness, **t** =		6	inches (compacted)			t_c	=	6 inch.
		9	inches (loose)			t_l	=	9 inch.

(a) For Intake Rate of 750 tons per day

W_{dw} = Daily waste intake rate = upper value of the range = 300 tons/day

V_{dw} = daily volume of waste = W_{dw} / γ_d = 500.00 cy = 13,500.00 cubic ft.

A_w = maximum area without cover = V_{dw}/D_w = **1,350.00** square ft.

SA_d = maximum daily surface area of working face ($SA_d = A_w + (2 \times D_w \times A_w^{1/2})$) = 2,084.85 square ft.

V_{dc} = volume of compacted daily cover soil = $SA_d \times t_c \times$ 1ft / 12 inch x 1 cy / 27 cft = **38.61** cy/day

V_{dcl} = volume of loose daily cover soil = $SA_d \times t_l \times$ 1ft / 12 inch x 1 cy / 27 cft **57.91** cy/day

Volume of compacted cover soil requirements for 3 days = V_{dc} x 3 = **115.82** cy/ 3 days

Volume of loose cover soil requirements for 3 days = V_{dcl} x 3 = **173.74** cy/ 3 days

Waste to Daily Cover Ratio = V_{dw}/V_{dc} = 12.95 ≈ **13 : 1**

Job:	Prince Edward County Sanitary Landfill
Job Number:	2223133.02 Phase 01
Calculated By:	DWT Date: 12/23/2022
Revised By:	Date:
Subject:	Queuing Analysis
Sheet:	1 of 2

(Working Face)

Given:

Maximum Waste Intake =	300	tons per day
Waste Delivered in Trailers =	15	avg tons per truck
Work Day (worst case) =	8	hours
Provided Queuing Distance =	760	feet (Not including the working face)(from the working face to the scales)

Maximum Waste Intake

Peak hourly usage = 20% of maximum daily intake =	60	tons per hour (tph)		
Loads per hour =	4	trucks arriving per hour =	15	minutes
Typical processing time =	15	minutes per load		
Number of loads processing at a time =	2			

Maximum Waste Intake

Average hourly usage = 12% of maximum daily intake =	36	tons per hour (tph)		
Loads per hour =	2	trucks arriving per hour =	25	minutes
Typical processing time =	15	minutes per load		
Number of loads processing at a time =	2			

Vehicle	**Arrival Time**	**Begin Processing Time**	**End Processing Time**	**Maximum Vehicles in Queue Not Processing**
1	6:00	6:00	6:15	0
2	6:15	6:15	6:30	0
3	6:30	6:30	6:45	0
4	6:45	6:45	7:00	0
5	7:00	7:00	7:15	0
6	7:15	7:15	7:30	0
7	7:30	7:30	7:45	0
8	7:45	7:45	8:00	0
9	8:00	8:00	8:15	0
10	8:15	8:15	8:30	0
11	8:30	8:30	8:45	0
12	8:45	8:45	9:00	0
13	9:00	9:00	9:15	0
14	9:15	9:15	9:30	0
15	9:30	9:30	9:45	0
16	9:55	9:55	10:10	0
17	10:20	10:20	10:35	0
18	10:45	10:45	11:00	0
19	11:10	11:10	11:25	0
20	11:35	11:35	11:50	0
21	12:00	12:00	12:15	0
22	12:25	12:25	12:40	0
23	12:50	12:50	13:05	0
24	13:15	13:15	13:30	0
25	13:40	13:40	13:55	0
26	14:05	14:05	14:20	0
27	14:30	14:30	14:45	0

Job:	Prince Edward County Sanitary Landfill
Job Number:	2223133.02 Phase 01
Calculated By:	DWT	Date: 12/23/2022
Revised By:		Date:
Subject:	Queuing Analysis
Sheet:	2 of 2

(Scalehouse)

Given:

Maximum Waste Intake =	300 tons per day
Waste Delivered in Trailers =	15 avg tons per truck
Work Day (worst case) =	8 hours
Provided Queuing Distance =	620 feet (Not including the scales)(from scales to the last driveway on the landfill access road)

Maximum Waste Intake

Peak hourly usage = 20% of maximum daily intake =	60 tons per hour (tph)	
Loads per hour =	4 trucks arriving per hour =	15 minutes
Typical processing time =	10 minutes per load	
Number of loads processing at a time =	1	

Maximum Waste Intake

Average hourly usage = 12% of maximum daily intake =	36 tons per hour (tph)	
Loads per hour =	2 trucks arriving per hour =	25 minutes
Typical processing time =	10 minutes per load	
Number of loads processing at a time =	1	

Vehicle	Arrival Time	Begin Processing Time	End Processing Time	Maximum Vehicles in Queue Not Processing
1	6:00	6:00	6:10	0
2	6:15	6:15	6:25	0
3	6:30	6:30	6:40	0
4	6:45	6:45	6:55	0
5	7:00	7:00	7:10	0
6	7:15	7:15	7:25	0
7	7:30	7:30	7:40	0
8	7:45	7:45	7:55	0
9	8:00	8:00	8:10	0
10	8:15	8:15	8:25	0
11	8:30	8:30	8:40	0
12	8:45	8:45	8:55	0
13	9:00	9:00	9:10	0
14	9:15	9:15	9:25	0
15	9:30	9:30	9:40	0
16	9:55	9:55	10:05	0
17	10:20	10:20	10:30	0
18	10:45	10:45	10:55	0
19	11:10	11:10	11:20	0
20	11:35	11:35	11:45	0
21	12:00	12:00	12:10	0
22	12:25	12:25	12:35	0
23	12:50	12:50	13:00	0
24	13:15	13:15	13:25	0
25	13:40	13:40	13:50	0
26	14:05	14:05	14:15	0
27	14:30	14:30	14:40	0

Conclusion: Maximum vehicles in queue will be 0 trailers. At 75 feet length per truck, will need 0 feet for queuing length, which is less than the 620 feet provided

Typical Landfill Equipment, Personnel, Working Face Size, and Weekly Cover Soil Needs By Daily Intake Rate

Range of Daily Intake Rate (tons/day)	Equipment		Personnel per Shift	Surface Area of Working Face (sf)	Three Days Cover Soil Needs (cubic yard)
	Equipment Type and Use	Operating Units			
0 - 325	Dozer (spread refuse and cover, compact waste, berm construction) (backup equipment) Compactor (spread, compact waste and cover material) Scraper pan (haul cover material) Loaders (optional)	 1 1	Site Manager: 1 Operators: 1 Laborers: 1	Lift Height= 10' SAWF = 1,500 sf	190 cy
325 - 650	Dozer (spread refuse and cover, compact waste, berm construction) (backup equipment) Compactor (spread, compact waste and cover material) Scraper pan (haul cover material) Loaders (optional)	1 2 1	Site Manager: 1 Operators: 3 Laborers: 1	Lift Height= 10' SAWF = 3,000 sf	340 cy
650 -1,000	Dozer (spread refuse and cover, compact waste, berm construction) (backup equipment) Compactor (spread, compact waste and cover material) Scraper pan (haul cover material) Loaders (optional)	1 3 1	Site Manager: 1 Operators: 3 Laborers: 1	Lift Height= 10' SAWF = 4,500 sf	490 cy
1,000-1,350	Dozer (spread refuse and cover, compact waste, berm construction) (backup equipment) Compactor (spread, compact waste and cover material) Scraper pan (haul cover material) Loaders (optional)	1 3 1	Site Manager: 1 Operators: 3 Laborers: 1	Lift Height= 10' SAWF = 6,100 sf	640 cy

Notes:

1. Compactor(s) will be CAT 826 or equivalent. Dozer(s) will be CAT D5, CAT D8 or equivalent. Track Loader(s) will be CAT 963 or equivalent. Rubber Tire Scrapers will be Terex TS14B or equivalent.
2. Equipment and manpower needs are based on operating Daily during an 8 hour shift.
3. Intake Rate reflects in-place compacted volume.

RESOURCE
INTERNATIONAL, LTD.
POST OFFICE BOX 6160
ASHLAND, VIRGINIA 23005
(804) 550-9200

JOB PEZ 90094.16
SHEET NO. 3 OF 3
CALCULATED BY JEA DATE 11/15/00
CHECKED BY DATE
SCALE

- STOCKPILE OF DAILY COVER MATERIAL

TOP: (508)(0.5) = 254 CF

SIDE: (381)(0.5) = 191 CF

WORKING FACE: (1200)(0.5) = 600 CF

TOTAL 1045 CF = 39 CY

MINIMUM STOCKPILE = 3 (DAILY COVER AMOUNT)

= 3(39) = 117 CY.

RESOURCE INTERNATIONAL, LTD.
POST OFFICE BOX 6160
ASHLAND, VIRGINIA 23005
(804) 550-9200

- FROM 3D DAILY CELLS:

COVER MATERIAL NEEDED:

TOP: $\overbrace{(12.7)(40)}^{508\text{ SF}}(0.5)(2) = 508$ CF
(DAILY & INT.)

SIDE: $\overbrace{(12.7)(30)}^{381\text{ SF}}(0.5)(2) = 381$ CF
(DAILY & INT)

WORKING FACE: $\overbrace{(30)(40)}^{1200\text{ SF}}(0.5) = 600$ CF
(DAILY ONLY)

TOTAL = 1489 CF = 55 CY

- DETERMINE WASTE: SOIL RATIO

WASTE: $\frac{4547\text{ CF}}{(4547+1489)}(100) = 75.3$

∴ SOIL ≈ 25% ⟹ USE WASTE: SOIL RATIO = 3:1

- FROM 1998 VOLUME & DENSITY ANALYSIS: (CELL A)

- GATE TONS = 29,641 T (~1% DIVERTED – TIRES, BRUSH ETC.)
- VOLUME USED IN CELL A = 62,406 CY

DENSITY ESTIMATE

$$\frac{(29{,}641)(.99)\,T}{(62{,}406)(0.75)\,CY} = 0.627\ T/CY \approx 1250\ PCY.$$

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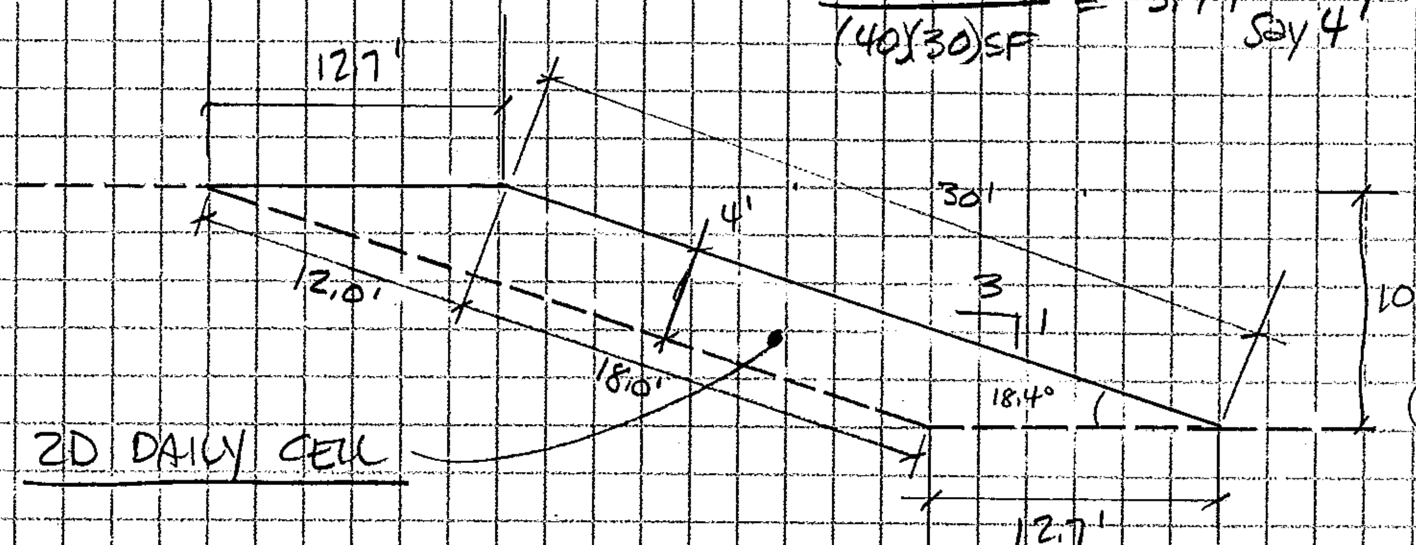
ASHLAND, VIRGINIA 23005
(804) 550-9200

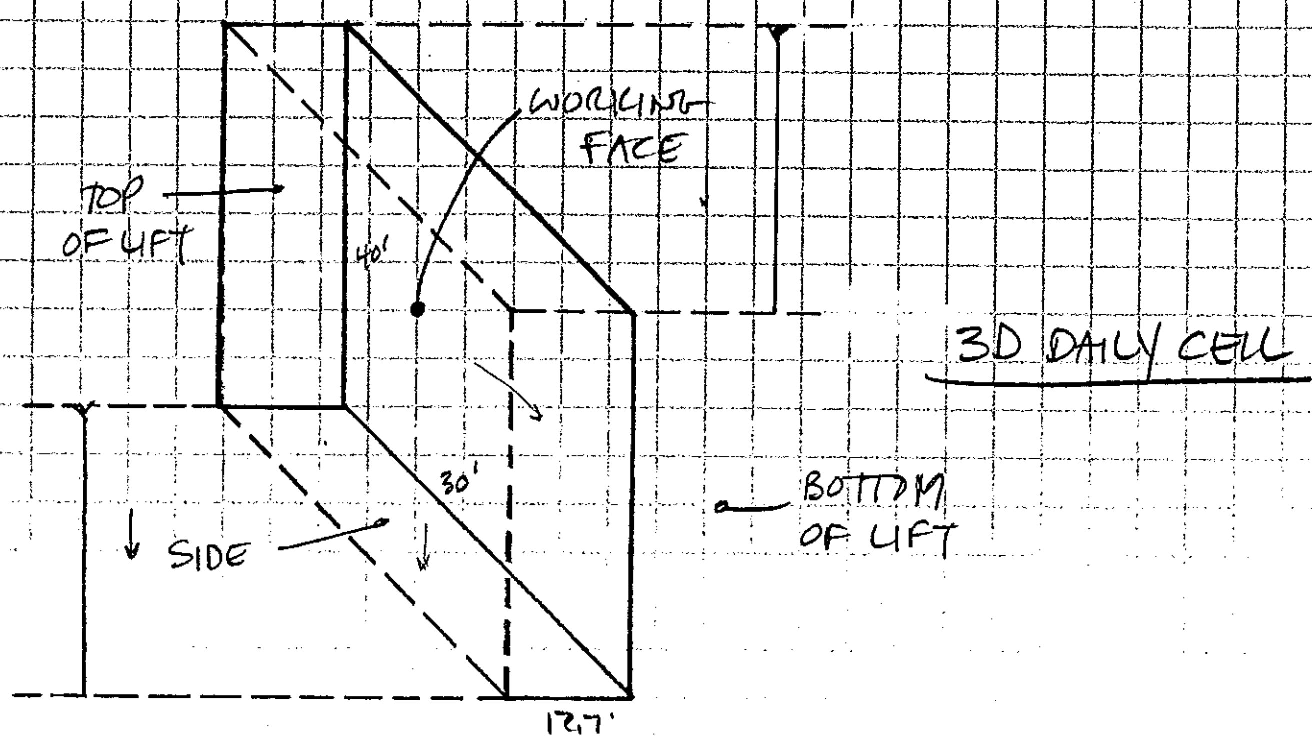
JOB: PEC 90094.16
SHEET NO.: 1 OF: 3
CALCULATED BY: JCA DATE: 9/19/00
CHECKED BY: DATE:
SCALE:

- DAILY CELL & COVER

$$\left(80\,T/DAY\right)\left(\frac{CY}{0.475\,T}\right)\left(\frac{27\,CF}{CY}\right) = 4547\ CF$$

- WORKING FACE ≈ 40' X 30' ⟹ $\frac{4547\ CF}{(40)(30)\ SF} = 3.79'$ say 4'





Prince Edward County Landfill - Permit 584
*Soil Balance**

	Units	Cells A & B	Cell C	Cell D	Cell E	Cell F	Total
	ac	7.70	3.35	3.52	3.46	3.44	
Excavation, topsoil	cy	11,492	4,145	3,548	3,463	3,403	26,051
Closure Topsoil	cy	(4,372)	(2,977)	(2,501)	(2,896)	(4,896)	(17,642)
Total; surplus, (deficit)	cy	7,120	1,168	1,047	567	(1,493)	8,409
Excavation, soil	cy	211,614	79,021	34,402	84,048	82,857	491,942
Fill	cy	(18,207)	(23,957)	(8,488)	(3,352)	(16,013)	(70,017)
Daily Cover	cy	(90,262)	(54,550)	(48,488)	(58,063)	(64,681)	(316,044)
Intermediate Cover	cy	(38,684)	(23,378)	(20,781)	(24,884)	(27,720)	(135,447)
Closure Cover Soil	cy	(13,116)	(8,930)	(7,502)	(8,688)	(14,689)	(52,925)
Closure Diversion Berm Fill	cy	(3,865)	(1,290)	(1,837)	(2,423)	(3,991)	(13,406)
Total; surplus, (deficit)	cy	47,480	(33,084)	(52,694)	(13,362)	(44,237)	(95,897)
Surplus (Deficit) from previous cells	cy	0	47,480	14,396	(38,298)	(51,660)	
Net Surplus (Deficit)	cy	47,480	14,396	(38,298)	(51,660)	(95,897)	

* - Based on general on-going closure construction quantities. Soil liner volume not included due to the use of an offsite borrow source.

ATTACHMENT VI

APPENDIX I
General Cell Construction Quantities
Design Calculations

PRINCE EDWARD COUNTY SANITARY LANDFILL
PRINCE EDWARD COUNTY, VIRGINIA

P.N. 90094.18

April 2013

Prince Edward County Landfill - Permit 584
General Cell Construction Quantities

	Units	Cells A & B	Cell C	Cell D	Cell E	Cell F
	Ac	7.7	3.35	3.52	3.46	3.44
Excavation, topsoil	cy	11,492	4,145	3,548	3,463	3,403
Excavation, soil	cy	211,614	79,021	34,402	**55,342**	**54,151**
Fill	cy	18,207	23,957	8,448	**4,935**	**17,551**
Clay Liner	cy	24,845	10,809	11,358	**N/A**	**N/A**
GCL	sf	N/A	N/A	N/A	**16,746**	**16,650**
Geomembrane Liner	sf	37,268	16,214	17,037	16,746	16,650
Cushion Geotextile	sf	877	16,214	17,037	16,746	16,650
Leachate Drainage Layer	cy	18,634	8,107	8,518	8,373	8,325
Filter Geotextile	sf	37,268	16,214	17,037	16,746	16,650
Leachat Collection Pipe 8-inch	lf	900	N/A	N?A	N/A	N/A
Leachate Collection Pipe 6-inch	lf	3,400	1,735	1,695	1,794	1,472
Sideslope Riser	lf	N/A	200	N/A	N/A	N/A
Pump	ea	N/A	1	N/A	N/A	N/A
Gravity Pipe	lf	465	N/A	N/A	N/A	N/A
Force Main	lf	N/A	1,500	N/A	N/A	N/A
Manholes	ea	2	4	N/A	N/A	N/A

APPENDIX 2-J

CLOSURE CAP SYSTEM DESIGN

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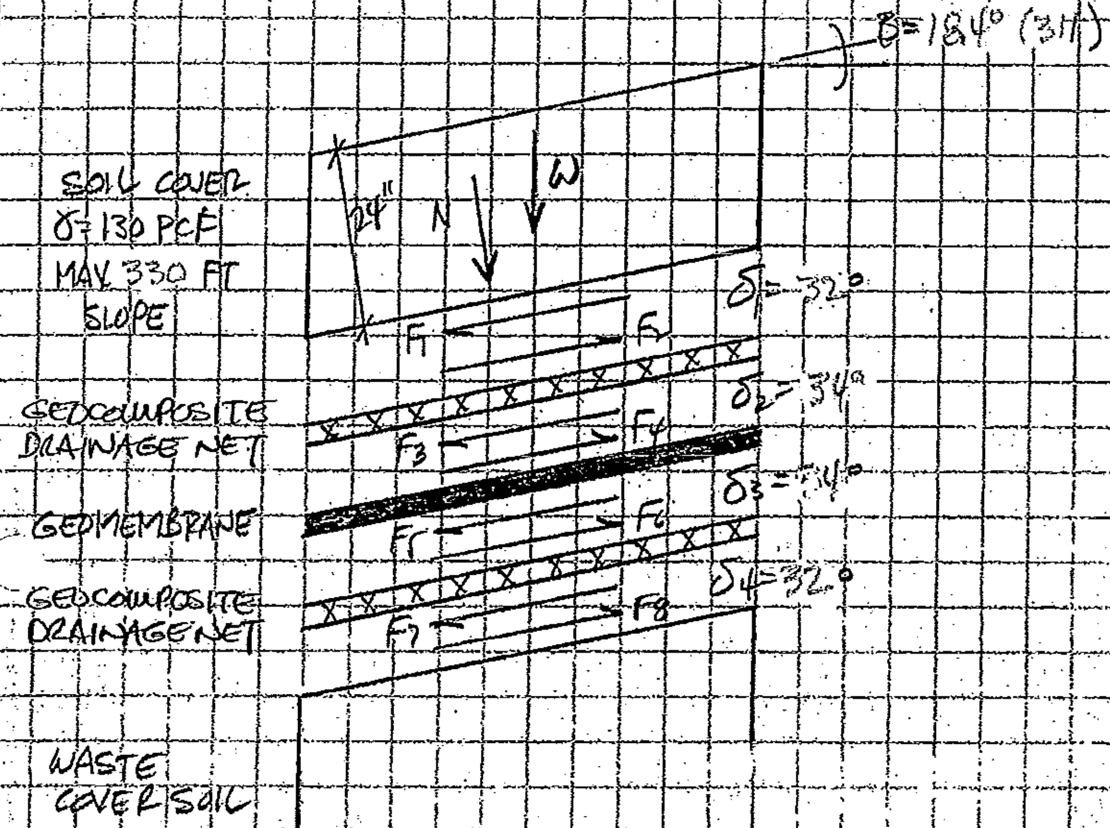
A) ALTERNATE CAP SYSTEM - CELLS A & B

1. CAP SYSTEM STRESSES



$W = (2)(330)(130) = 85{,}800$ LB/FT

$F_1 = W\sin\beta = (85{,}800)(\sin 18.4) = 27{,}083$ LB/FT

$N = W\cos\beta = (85{,}800)(\cos 18.4) = 81{,}413$ LB/FT

$F_2 = N\tan\delta_1 = (81{,}413)(\tan 32) = 50{,}872$ LB/FT

$\sum_1^1 F = F_2 - F_1 = (50872 - 27{,}083) = 23{,}789$ LB/FT

* SINCE $F_2 > F_1$, THE COVER IS STABLE.

$FS = 50{,}872 / 27{,}083 = 1.9$

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* SINCE $F_2 > F_1$, F_2 IS MOBILIZED ONLY TO THE EXTENT OF F_1. THEREFORE, $F_2 = F_1$ AND $F_2 = F_3 = 27,083$ LB/FT

$F_4 = N \tan\delta_2 = (81,413)(\tan 36) = 54,914$ LB/FT

$\Sigma_1 = F_4 - F_3 = (54,914 - 27,083) = 27,831$ LB/FT

* SINCE $F_4 > F_3$, THE GDN IS STABLE.

$FS = 54,914 / 27,083 = 2.0$

* SINCE $F_4 > F_3$, F_4 IS MOBILIZED ONLY TO THE EXTENT OF F_3. THEREFORE, $F_4 = F_3$, AND $F_4 = F_5 = 27,083$ LB/FT

* SINCE $\delta_3 = \delta_2$, $F_6 = F_5$, AND $F_7 = F_6 = 27,083$ LB/FT

$F_8 = N \tan\delta_4 = (81,413)(\tan 32) = 50,872$ LB/FT

$\Sigma_1 F = F_8 - F_7 = (50,872 - 27,083) = 23,789$ LB/FT

* SINCE $F_8 > F_7$, CAP SYSTEM IS STABLE.

$FS = \frac{50,872}{27,083} = 1.9$ NONE OF THE GEOSYNTHETICS ARE IN TENSION.

2. SELF-WEIGHT

* CONSIDER THREE LAYERS OF GEOSYNTHETICS

2 GEOCOMPOSITE DRAINAGE NET : 0.35 LB/FT^2
1 LLDPE GEOMEMBRANE : 1.88 LB/FT^2

TOTAL = 2.23 LB/FT^2

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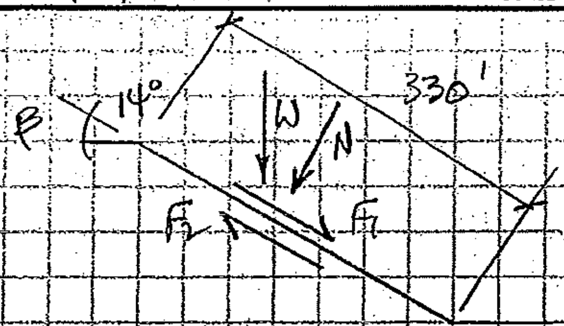


$W = (330)(2.23) = 736$ LB/FT
$F_1 = W \sin\beta = (736)(\sin 18.4) = 232$ LB/FT
$N = W \cos\beta = (736)(\cos 18.4) = 698$ LB/FT
$F_2 = N \tan\delta = 698 \tan\delta$

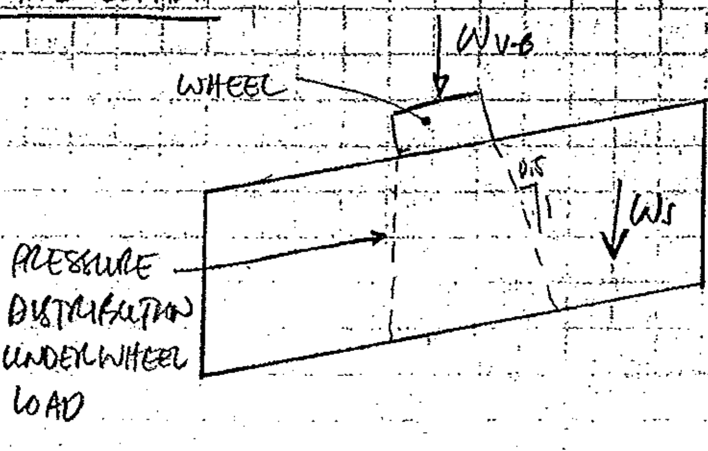
SET $FS = 2.0 = \dfrac{F_2}{F_1} = \dfrac{698 \tan\delta}{232}$

SOLVE FOR δ

$$\delta = \tan^{-1}\left(\frac{(2)(232)}{698}\right) = 33.7°$$

* INTERFACE FRICTION AT NO LOAD MUST EQUAL 33.7°. ALTERNATIVELY, ADHESION AT NO LOAD MUST EQUAL 2(2.23) = 4.46 LB/FT². THIS APPLIES TO ALL INTERFACES.

3. TRAFFIC LOADS



W_{V-B} = EFFECTIVE VEHICLE WEIGHT AT BRAKING; EST (1.3)(STATIC WEIGHT)

W_S ~ WEIGHT OF SOIL

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A) CONSIDER CAT D6H LGP DOZER
$W_V = 43{,}700$ LB ON TWO 3'X10.7' TRACKS

EACH TRACK IMPARTS 21,850 LB

$W_{V\text{-}B} = (1.3)(21{,}850) = 28{,}405$ LB

AREA AT BOTTOM OF 12" OF COVER SOIL (FIRST LIFT)

$(3'+1')(10.7'+1') = 46.8$ SF

$W_S = (1)(130)(46.8) = 6084$ LB

$W_S + W_{VB} = 6084 + 28{,}405$ LB $= 34{,}489$ LB

$F_1 = (W_S + W_{V\text{-}B})(\sin\beta) = (34{,}489)(\sin 18.4) = 10{,}886$ LB

$N = (W_S + W_{V\text{-}B})(\cos\beta) = (34{,}489)(\cos 18.4) = 32{,}726$ LB

$F_2 = N \tan\delta_1 = (32{,}726)(\tan 32) = 20{,}449$ LB

$\nearrow \Sigma_1 F = F_2 - F_1 = (20{,}449 - 10{,}886) = 9563$ LB

∗ SINCE $F_2 > F_1$, THE COVER IS STABLE.

$FS = \frac{F_2}{F_1} = \frac{20{,}449}{10{,}886} = 1.9$

GEOSYNTHETIC LAYERS ARE NOT IN TENSION.

B) CONSIDER CAT 815C SELF-PROPELLED SOIL COMPACTOR
$W_V = 44{,}175$ LB ON FOUR 3.2'X1.5' WIDE DRUMS

EACH DRUM IMPARTS 11,044 LB

$W_{V\text{-}B} = (1.3)(11{,}044) = 14{,}357$ LB

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JOB PEC 58F - ALT. CAP SYSTEM
SHEET NO. 5 OF 20
CALCULATED BY JCA DATE 4/15/03
CHECKED BY ______ DATE ______
SCALE ______

AREA AT BOTTOM OF 12" OF COVER SOIL (FIRST LIFT)

$(3.2+1)(1.5+1) = 10.5$ SF

$W_S = (1)(130)(10.5) = 1365$ LB

$W_S + W_{V-B} = 1365 + 14,357$ LB $= 15,722$ LB

$F_1 = (W_S + W_{V-B})(\sin\beta) = (15,722)(\sin 18.4) = 4963$ LB

$N = (W_S + W_{V-B})(\cos\beta) = (15,722)(\cos 18.4) = 14,918$ LB

$F_2 = N \tan\delta_1 = (14,918)(\tan 32) = 9322$ LB

$\nearrow \Sigma F = F_2 - F_1 = 9322 - 4963 = 4359$ LB

∴ SINCE $F_2 > F_1$, THE COVER IS STABLE

$FS = \frac{9322}{4963} = 1.9$ GEOSYNTHETIC LAYERS ARE NOT IN TENSION.

c) CONSIDER CAT D40D ARTICULATING DUMP
$W_V = 164,760$ LB (GROSS) 61% REAR WHEELS = 100,607 LB
= 50,304 LB/WHEEL

$W_{V-B} = (1.3)(W_V) = (1.3)(50,304) = 65,395$ LB

CONTACT AREA:
EST CONTACT PRESSURE = TIRE PRESSURE = 70 PSI

$AREA = \frac{50,304 \text{ LB}}{70 \text{ LB/IN}^2} = 719 \text{ IN}^2$

ASSUME AREA = (L)(0.6L)
$L = \sqrt{\frac{719}{0.6}} = 34.6" = 2.9'$ $0.6L = 1.7'$

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AREA AT BOTTOM OF 12" OF COVER SOIL (FIRST LIFT)

$(2.9+1)(1.7+1) = 10.5 \text{ SF}$

$W_S = (1)(130)(10.5) = 1365 \text{ LB}$

$W_S + W_{V\text{-}B} = (1365 + 65,395) = 66,760 \text{ LB}$

$F_1 = (W_S + W_{V\text{-}B})(\sin\beta) = (66,760)(\sin 18.4) = 21,073 \text{ LB}$

$N = (W_S + W_{VB})(\cos\beta) = (66,760)(\cos 18.4) = 63,347 \text{ LB}$

$F_2 = N \tan\delta_1 = (63,347)(\tan 32) = 39,583 \text{ LB}$

$\nearrow \Sigma F = F_2 - F_1 = 39,583 - 21,073 = 18,510 \text{ LB}$

*SINCE $F_2 > F_1$, CAP IS STABLE.

$FS = \dfrac{39,583}{21,073} = 1.9$

GEOSYNTHETIC LAYERS ARE NOT IN TENSION.

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4. LOCALIZED SETTLEMENT

40-MIL LLDPE-T $t = 0.040$

$\sigma_{br} = 60$ LB/IN $\epsilon_{br} = 13\%$
$= 1500$ LB/IN²

SOIL COVER = 2' @ 130 PCF.

p = OVERBURDEN STRESS $= (2FT)(130 LB/FT^3)\left(\frac{FT^2}{144 IN^2}\right) = 1.81$ PSI

σ_t = STRESS IN GEOMEMBRANE

$= pR/2t'$

R = RADIUS OF CURVATURE OF SUBSIDENCE IN

Assume $t' = 27$ mils (VERIFY LATER)

t' = REDUCED THICKNESS OF GEOMEMBRANE AFTER DEFORMATION, IN

$$R = \frac{(1500)(0.027)(2)}{1.81} = 44.75''$$

$$\epsilon = (\sqrt{2})\left[(R/l)\sin^{-1}(l/R) - 1\right]^{-1}$$

$$\frac{\epsilon}{\sqrt{2}} = \left[\frac{\sin^{-1}(l/R)}{(l/R)} - 1\right]^{-1} = \frac{0.13}{1.414}$$

$$0.092 = \frac{\sin^{-1}(l/R)}{(l/R)} - 1 \Longrightarrow$$

CALCULATOR MUST BE IN THE RADIAN MODE, NOT DEGREES

BY TRIAL & ERROR, SOLVE FOR $(l/R) = 0.66$

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JOB: PEC 584 - ALT CAP SYSTEM
SHEET NO. 8 OF 10
CALCULATED BY: JCA DATE: 4/11/03
CHECKED BY: DATE:
SCALE:

$\frac{l}{R} = 0.66 \qquad l = 0.66(44.75) = 29.53''$

Δ = SETTLEMENT

$$R = \left(\frac{l^2}{2\Delta} + \frac{\Delta}{2}\right)$$

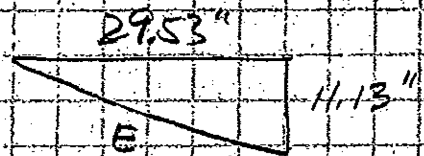
$$44.75 = \frac{29.53^2}{2\Delta} + \frac{\Delta}{2}$$

$$44.75 = \frac{436}{\Delta} + \frac{\Delta}{2}$$

BY TRIAL & ERROR, $\Delta = 11.13''$

$$\epsilon' = \frac{(\epsilon)(l)}{(1.414)(R)(\sin^{-1}(l/R))} = \frac{(0.04)(29.53)}{(1.414)(44.75)(\sin^{-1}(0.66))}$$

$= 0.026 \rightarrow$ CLOSE TO 0.027 INITIALLY ASSUMED



$E = \sqrt{29.53^2 + 11.13^2} = 31.56''$

$$\epsilon\% = \left(\frac{31.56 - 29.53}{29.53}\right)(100) = 6.87\% < 13\%$$

THEREFORE, GEOMEMBRANE SHOULD NOT YIELD.

$$FS = \frac{\epsilon_y}{\epsilon_{act}} = \frac{13}{6.9} = 1.9$$

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5. CAP DRAINAGE LAYER - GEOCOMPOSITE DRAINAGE NET

SLOPE LENGTH BETWEEN DRAINS, L = 65 FT

SLOPE = 3 TO 1 i = 0.333

PERMEABILITY OF COVER SOILS, K_{VEG} = 2.22×10^{-4} cm/sec

REDUCTION FACTORS

RF_{IN} (INTRUSION) = 1.5
RF_{CR} (CREEP) = 1.4
RF_{CC} (CHEMICAL CLOGGING) = 1.2
RF_{BC} (BIOLOGICAL CLOGGING) = 1.5

PRODUCT OF REDUCTION FACTORS = 3.78
(PRF)

REQUIRED TRANSMISSIVITY, $\theta_r = (K_{VEG})(L)/i = 1.32 \times 10^{-4}$ m²/sec

ULTIMATE TRANSMISSIVITY, $\theta_u = 1 \times 10^{-3}$ m²/sec (MANUF. DATA)

ALLOWABLE TRANSMISSIVITY, $\theta_a = \dfrac{\theta_u}{PRF} = \dfrac{1 \times 10^{-3} \text{ m}^2/\text{sec}}{3.78}$

$= 2.65 \times 10^{-4}$ m²/sec

DESIGN FACTOR OF SAFETY, $FS = \dfrac{\theta_a}{\theta_r} = 2.005$

MINIMUM DESIGN FACTOR OF SAFETY = 2.0

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GEOTEXTILE DESIGN

$Q = K L \cos\beta$

K = SOIL PERMEABILITY
L = SLOPE LENGTH BETWEEN DRAINS
β = SLOPE ANGLE

$K = 2.22 \times 10^{-4}$ cm/sec

$L = 65' = 1981$ cm

$\beta = 18.4°$ (3:1)

$Q = (2.22 \times 10^{-4})(1981)(\cos 18.4) = 0.417\ cm^2/sec$

$Q = KiA = K\frac{\Delta h}{t}A = \Psi_{all}\,\Delta h\,L$ $\Delta h = 2' = 61$ cm

$\Psi_{all} = \frac{Q}{\Delta h L} = \frac{(0.417\ cm^2/sec)}{(61\ cm)(1981\ cm)} = 3.45 \times 10^{-6}\ sec^{-1}$

$\Psi_{all} = \frac{\Psi_{ult}}{(PRF)}$

Ψ_{ult} = ULTIMATE PERMITTIVITY

PRF = PRODUCT OF REDUCTION FACTOR & FACTOR OF SAFETY

$FS = 2.0$
$RF_{SC} = 3.0$
$RF_{CR} = 1.4$ PRF = 22.68
$RF_{IN} = 1.5$
$RF_{CC} = 1.2$
$RF_{BC} = 1.5$

$\Psi_{ult} = (22.68)(3.45 \times 10^{-6}\ sec^{-1})$

$= 7.82 \times 10^{-5}\ sec^{-1}$

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NOTE Ψ_{ult} FOR 6oz NON-WOVEN = 1.3 sec^{-1} > 7.82×10^{-5} sec^{-1}

AOS = SIEVE 70 = 0.21 mm

FOR ADEQUATE SOIL RETENTION,

$AOS = O_{95} < (2 \text{ TO } 3)(d_{85} \text{ of soil})$

onsite soils:

d_{85} range from 0.50 mm to 0.67 mm

Avg = 0.69 mm

$(2 \text{ TO } 3)(d_{85}) = (2 \text{ TO } 3)(0.69 \text{ mm})$

= 1.38 mm to 2.07 mm

0.21 mm < 1.38 mm to 2.07 mm

∴ geotextile provides adequate soil retention

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JOB PEC-584 ALT CAP SYSTEM
SHEET NO. 12 OF 20
CALCULATED BY JGA DATE 4/11/03
CHECKED BY DATE
SCALE

CONSIDER THE FOLLOWING EQUIPMENT IMPOSED PRESSURES:

- CAT D6H LGP DOZER

$$\sigma_V = \frac{28{,}405 \text{ LB}}{46.8 \text{ SF}} = 607 \text{ PSF}$$

- CAT 815C SOIL COMPACTOR

$$\sigma_V = \frac{14{,}357 \text{ LB}}{10.5 \text{ SF}} = 1367 \text{ PSF}$$

- CAT D40D DUMP

$$\sigma_V = \frac{66{,}760 \text{ LB}}{10.5 \text{ SF}} = 6358 \text{ PSF}$$

- INCREASE DEPTH OF SOIL BENEATH TIRES TO 4 FEET

$$\sigma_V = \frac{66{,}760 \text{ LB}}{(2.9+4)(1.7+4) \text{ SF}} = 1697 \text{ PSF}$$

BI-PLANAR OR TRI-PLANAR GEOCOMPOSITES ARE ACCEPTABLE PROVIDED THE ULTIMATE TRANSMISSIVITY OF 1×10^{-3} M²/SEC IS ACHIEVED UNDER A VERTICAL PRESSURE OF 2,000 PSF OR GREATER.

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JOB PEC 584 - ALT CAP SYSTEM
SHEET NO. 13 OF 20
CALCULATED BY CKA DATE 4/11/03
CHECKED BY DATE
SCALE

6. DRAIN DESIGN

- USE $Q_{in} = 4.17 \times 10^{-5}\ m^3/sec = 4.17 \times 10^{-5}\ m^3/sec\text{-}m$

$$Q = \left(4.17 \times 10^{-5} \frac{m^3}{sec\text{-}m}\right)\left(\frac{3.28^3\ FT^3}{m^3}\right)\left(\frac{m}{3.28\ FT}\right) = 4.49 \times 10^{-4} \frac{CF}{SEC\text{-}FT}$$

- THE LONGEST DRAIN IS 1100 FT

$$Q = (1100\ FT)\left(4.49 \times 10^{-4} \frac{CF}{SEC\text{-}FT}\right) = 0.49\ CFS$$

- PERFORATED PIPE - 4" DIAM

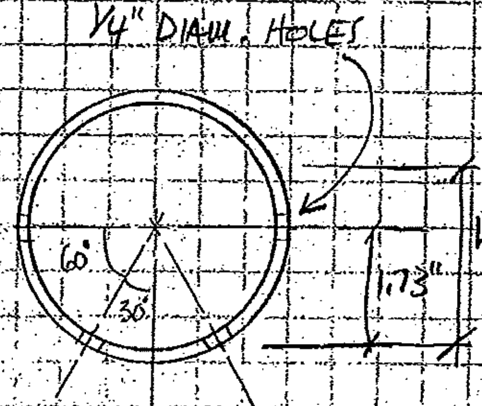
$Q = CA\sqrt{2gh}$

$C = 0.634$

A = AREA OF SINGLE HOLE $= 0.05\ in^2 = 3.4 \times 10^{-4}\ FT^2$

$g = 32.2\ FT/SEC^2$

h = HEAD

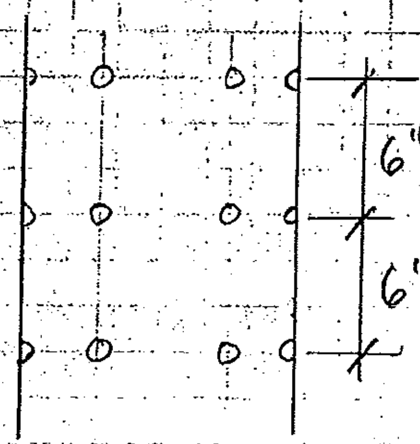


- ON A PER FT BASIS:
4 LOWER HOLES & 0.35 CFS

$$3.2 \times 10^{-4} = 0.634(4)(3.4 \times 10^{-4})\sqrt{2(32.2)h}$$

$$\frac{\left(\dfrac{3.2 \times 10^{-4}}{(0.634)(4)(3.4 \times 10^{-4})}\right)^2}{2(32.2)} = h = 2 \times 10^{-3}\ FT$$

IF ONLY LOWER HOLES ARE USED.



* THEREFORE, HOLES AT MID-DEPTH ADD GREATER CAPACITY TO DRAIN.

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- SLOPE = 10'/440' = 0.0227 FT/FT

MANNING'S n = 0.012

$Q = VA \left(\frac{1.49}{n}\right)\left(R_h^{2/3}\right)\left(S^{1/2}\right)$

V = velocity
A = flow area
R_h = hydraulic radius
S = slope

- SOLVE MANNING'S FORMULA FOR Q = 0.49 CFS, n = 0.012, S = 0.0227

V = 4.3 FPS

d = depth = 3.1"

diam = 6" ⟹ KEEP SAME PERFORATION PATTERN AS PREVIOUSLY DESCRIBED FOR 4" PIPE

- CHECK STRUCTURAL STABILITY OF DRAIN PIPE

NOTE: THE FOLLOWING METHODOLOGY IS WIDELY ACCEPTED IN THE HDPE PIPE INDUSTRY. SOIL ARCHING THEORY IS INCORPORATED INTO THE DESIGN TO REDUCE THE DESIGN STRESSES ON THE PIPE. THE MODULUS OF SOIL REACTION (E') IS CALCULATED USING ELASTIC THEORY METHODS TO ACCOUNT FOR CONFINEMENT OF THE PIPE IN A WELL-BEDDED MATERIAL, AND FOR OVER-BURDEN PRESSURE.

<u>EXTERNAL PRESSURE ON PIPE</u> (P_E)

FROM PREVIOUS CALCULATION, GREATEST POTENTIAL VERTICAL PRESSURE = 1697 PSF = 11.8 PSI

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CORRECT Pt FOR SOIL ARCHING (Pta)

$P_{ta} = \frac{1}{2}(1+K_o)P_t$

K_o = COEFF. OF EARTH PRESSURE AT REST $= (1-\sin\phi)$

$= \frac{1}{2}(1+(1-\sin 32))(11.8)$

$\phi = 32°$ FOR GRAVEL

$= 8.7$ PSI

ADJUST Pta FOR PIPE PERFORATIONS (Ptaf)

$P_{taf} = \left(\frac{12}{12-L_p}\right)P_{ta}$

L_p = CUMMULATIVE LENGTH OF PIPE PERFORATIONS, IN (USING A UNIT ONE FOOT LENGTH)

$L_p = \left(8\frac{\text{HOLES}}{\text{FT}}\right)\left(0.25\frac{\text{IN}}{\text{HOLE}}\right) = 2\text{IN}$

$P_{taf} = \left(\frac{12}{12-2}\right)(8.7) = 10.4$ PSI

CHECK PIPE FOR WALL CRUSHING

$S_A = \left(\frac{SDR-1}{2}\right)(P_{taf})$

S_A = COMPRESSIVE STRESS ON PIPE

SDR = STANDARD DIMENSION RATIO, $SDR = 32.5$

$= \left(\frac{32.5-1}{2}\right)(10.4)$

$= 163.8$ PSI

σ_y = YIELD STRESS OF PIPE $= 1500$ PSI

FS = FACTOR OF SAFETY

$FS = \frac{\sigma_y}{S_A} = \frac{1500}{163.8} = 9.1 > 2$ ✓

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CHECK PIPE FOR WALL BUCKLING

BASED ON SA & TIME PERIOD OF 50 YEARS,
E_L = 30,000 PSI = MODULUS OF ELASTICITY

HYDROSTATIC CRITICAL COLLAPSE DIFFERENTIAL PRESSURE (P_C)

$$P_C = \frac{2.32(E_L)}{SDR^3} = \frac{(2.32)(30,000)}{(32.5)^3} = 2.0 \text{ PSI}$$

CRITICAL BUCKLING SOIL PRESSURE P_{CB}

$$P_{CB} = 0.8\sqrt{(E')P_C}$$

$$E' = \text{MODULUS OF SOIL REACTION} = \frac{E_S(1-V_S)}{(1+V_S)(1-2V_S)}$$

E_S = YOUNGS MODULUS

$$= KP_a\left(\frac{\sigma_3}{P_a}\right)^n\left[1 - \frac{R_f(1-\sin\phi)(\sigma_1-\sigma_3)}{2c\cos\phi + 2\sigma_3\sin\phi}\right]^2$$

V_S = POISSON'S RATIO = 0.4

K, n, R_f = HYPERBOLIC STRESS STRAIN PROPERTIES FOR COARSE GRAINED SOIL HAVING LESS THAN 5% FINES PASSING #200 SIEVE.

$K = 300 \quad n = 0.4 \quad R_f = 0.7$

c = cohesion = 0

σ_1 = normal stress = P_t = 11.8 PSI

σ_3 = CONFINING STRESS = $K_o\sigma_1 = (1-\sin\phi)\sigma_1$

P_a = ATMOSPHERIC PRESSURE = 14.7 PSI

$\sigma_3 = (1-\sin 32)(11.8) = 5.5$ PSI

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$$E_S = (300)(14.7)\left(\frac{5.5}{14.7}\right)^{0.4}\left[1 - \frac{(0.7)(1-\sin 32)(11.8-5.5)}{(2)(5.5)(\sin 32)}\right]^2$$

$$= (2976)(0.415) = 1235 \text{ PSI}$$

$$E = \frac{1235(1-0.4)}{(1+0.4)(1-2(0.4))} = 2646 \text{ PSI}$$

$$P_{CB} = 0.8\sqrt{(2646)(2)} = 58.2 \text{ PSI}$$

$$FS = \frac{P_{CB}}{P_{tal}} = \frac{58.2}{10.4} = 5.6 > 2$$ ✓

CHECK PIPE FOR RING DEFLECTION

ASSUME: THE VERTICAL STRAIN IN THE GRAVEL SURROUNDING THE PIPE IS THE SAME AS THE VERTICAL STRAIN IN THE PIPE.

$$\epsilon_c = \frac{P_E}{E'} = \epsilon_{actual}$$

- USE FULL OVERBURDEN PRESSURE

$$\epsilon_p = \epsilon_{all} = \frac{\Delta Y}{D} = 0.25\, \epsilon_t\, (SDR)$$

ϵ_p = STRAIN IN PIPE
ϵ_{all} = ALLOWABLE STRAIN IN PIPE
ϵ_t = ALLOWABLE TANGENTIAL STRAIN IN PIPE = 1.5%
ΔY = VERTICAL DEFLECTION, IN
D = PIPE DIAM, IN

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$$\epsilon_{actual} = \frac{P_L}{E'} = \frac{11.8}{2646} = 0.0044 = 0.44\%$$

$$\epsilon_{all} = 0.25(0.015)(32.5) = 0.122 = 12.2\%$$

$$FS = \frac{12.2}{0.44} = 27.7 > 2 \checkmark$$

7. GAS VENTING

$$Q_{gas} = \frac{W_W(0.1)}{A_c}$$

Q_{GAS} = GAS GENERATION, SCF/FT²/YR
W_W = WEIGHT OF WASTE, LB
0.1 = GENERATION RATE, SCF/YR/LB
A_c = AREA OF FINAL COVER, SF

$V_W = 36,570,587$ CF $\gamma_{WA} = 1250$ lb/cy
$A_c = 21.5$ AC $= 936,540$ SF

$$W_W = (36,570,587\,CF)\left(\frac{CY}{27\,CF}\right)\left(1250\,\frac{LB}{CY}\right) = 1,693,082,500\ LB$$

$$Q_{GAS} = \frac{(1,693,082,500)(0.1)}{936,540} = 180.8\ SCF/SF/YR$$

u_{max} = MAXIMUM GAS PRESSURE

$$= \frac{Q_{GAS}\,\gamma_{GAS}}{\theta_{req'd}}\left(\frac{L^2}{8}\right)$$

γ_{GAS} = DENSITY OF GAS ≈ 0.0815 PCF
L = LENGTH TO VENT/WELL
$\theta_{req'd}$ = REQUIRED TRANSMISSIVITY

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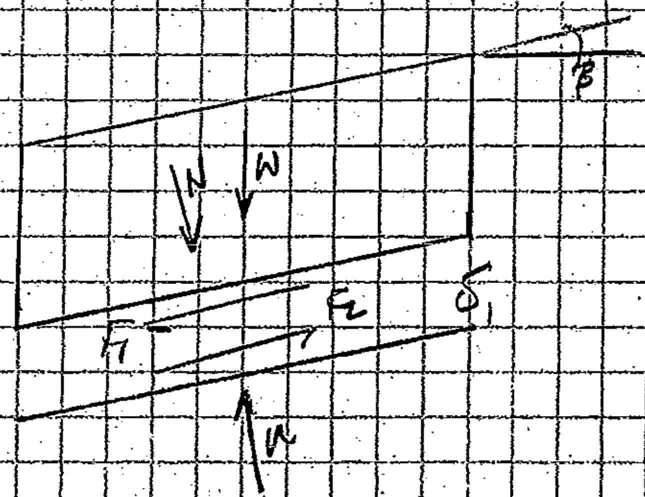
ESTIMATE u_{MAX} ALLOWED FROM THE CAP CALCULATIONS



$F_1 = 27{,}083$ LB/FT

$F_2 = (N-u)\tan\delta_1 = (W\cos\beta - u)(\tan 32)$

$= [85{,}800 \cos(18.4) - u] \tan 32$

$= (81{,}413 - u)(0.625) = 50{,}883 - 0.625u$

* ASSUME FS = 1.0,

$$1.0 = \frac{F_2}{F_1} = \frac{50{,}883 - 0.625u}{27{,}083}$$

$u = 38{,}080$ LB/FT

$$\left(\frac{38{,}080 \frac{LB}{FT}}{330\ FT}\right) = 115.4 \text{ PSF}$$

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$$\psi_{reqd} = \frac{Q_{GAS}\,\gamma_{GAS}}{u_{MAX}}\left(\frac{L^2}{E}\right)$$

$$= \frac{\left(180.8\ \frac{\cancel{CF}}{\cancel{SF}\text{-}YR}\right)\left(0.0475\ \frac{LB}{\cancel{CF}}\right)}{115.4\ \frac{LB}{SF}}\left(\frac{330^2\ FT^2}{8}\right)$$

$$= 1738\ \frac{FT^2}{YR}$$

$$\left(1738\ \frac{FT^2}{YR}\right)\left(\frac{m^2}{3.28^2\ FT^2}\right)\left(\frac{YR}{365\ D}\right)\left(\frac{D}{24\ HR}\right)\left(\frac{HR}{60\ MIN}\right)\left(\frac{MIN}{60\ SEC}\right) = 5.12\times10^{-6}\ \frac{m^2}{SEC}$$

$$\psi_{ULT\,GAS} = \psi_{REQD}\ \Pi RF$$

ΠRF = PRODUCT OF VARIOUS REDUCTION FACTORS, AS FOLLOWS:

RF_{IN} = INTRUSION = 1.5
RF_{CR} = CREEP = 1.4
RF_{BC} = BIOLOGICAL CLOGGING = 1.5
RF_{CC} = CHEMICAL CLOGGING = 1.2
FS = GLOBAL FACTOR OF SAFETY = 2.0

$$(FS)(\Pi RF) = (2)(3.78) = 7.6$$

$$\psi_{ULT\,GAS} = \left(5.12\times10^{-6}\ \frac{m^2}{SEC}\right)(7.6)$$

$$= 3.89\times10^{-5}\ m^2/SEC$$

$$\psi_{WATER} = 10\,(\psi_{GAS})$$

$$= 10\,(3.89\times10^{-5}\ m^2/SEC)$$

$$= 3.89\times10^{-4}\ m^2/SEC$$

BOTH BI-PLANAR AND TRI-PLANAR GEOCOMPOSITES EXIST THAT CAN PROVIDE THIS TRANSMISSIVITY. SPECIFICATIONS SHOULD ALLOW THE USE OF BOTH.

Comparison of Cap Performance
Prince Edward County Landfill
Permit No. 584

By: JCA
Date: 24-Mar-03

Year	Annual Precipitation, In.	Cap Leakage as a Percentage of Precipitation: Minimum Regulatory Cap	Cap Leakage as a Percentage of Precipitation: Proposed Alternate Cap
1	41.11	33.99	0.32
2	44.53	40.09	0.37
3	54.19	41.39	0.36
4	35.38	26.33	0.31
5	40.86	32.81	0.35
6	42.77	26.80	0.29
7	43.49	36.09	0.36
8	40.87	34.22	0.34
9	51.18	38.20	0.36
10	37.18	25.07	0.34
11	31.84	21.20	0.26
12	30.65	16.95	0.22
13	39.99	35.22	0.34
14	35.00	14.84	0.23
15	39.30	33.32	0.39
16	36.09	19.30	0.25
17	34.56	26.78	0.29
18	44.82	30.19	0.30
19	33.06	29.53	0.35
20	54.60	40.71	0.34
21	39.77	32.62	0.33
22	44.17	33.06	0.33
23	45.19	28.74	0.28
24	53.15	32.43	0.28
25	40.42	39.22	0.40
26	42.82	31.63	0.26
27	43.91	30.82	0.32
28	27.31	5.81	0.10
29	45.64	36.23	0.37
30	36.15	27.23	0.34

APPENDIX 2-K

GENERAL CLOSURE CONSTRUCTION QUANTITIES

Prince Edward County Landfill - Permit 584
General Closure Construction Quantities - Ongoing Operation

	Units	Phase I	Phase II	Phase III	Phase IV	Phase V
	ac	5.42	3.69	3.10	3.59	6.07
Topsoil, 6 in.	cy	4,372	2,977	2,501	2,896	4,896
Cover Soil, 18 in.	cy	13,116	8,930	7,502	8,688	14,689
Geocomposite	sy	52,466	35,720	30,008	34,752	58,758
Geomembrane	sy	26,233	17,860	15,004	17,376	29,379
Diversion Berms	lf	3,965	1,320	1,880	2,480	4,085
Diversion Berms	cy	3,865	1,290	1,837	2,423	3,991
Down-slope Channels	lf	725	560	150	390	455
Gas Vent Wells	lf	279	555	379	449	734

Prince Edward County Landfill - Permit 584
*Total Closure Construction Quantities - Premature Closure**

	Units	Phase I	Phase II	Phase III	Phase IV
	ac	7.70	6.03	5.86	6.22
Topsoil, 6 in.	cy	6,211	4,864	4,727	5,017
Cover Soil, 18 in.	cy	18,634	14,593	14,181	15,052
Geocomposite	sy	74,536	58,370	56,724	60,210
Geomembrane	sy	37,268	29,185	28,362	30,105
Diversion Berms	lf	5,427	2,905	3,470	4,480
Diversion Berms	cy	5,302	2,838	3,390	4,377
Down-slope Channels	lf	903	870	430	660
Gas Vent Wells	lf	551	748	613	672

* - Phase V closure not included because it does not represent a premature closure.